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Peninsula Restoration Group

Hackensack River Study Area Supplemental Remedial Investigation Work Plan

January 2009

Revision 0

CERTIFICATION

Pursuant to N.J.A.C. 7:26C-1.2

Regarding the *Hackensack River Study Area Supplemental Remedial Investigation Work Plan, Revision 0* dated January 2009 (including all attachments and enclosures, the "Submission") submitted herewith and prepared by ARCADIS of New York, Inc. for the Peninsula Restoration Group in connection with the investigation of an area of the Hackensack River adjacent to the Diamond Shamrock, Standard Chlorine Chemical and Koppers Seaboard sites located in Kearny, NJ ("Study Area"), the undersigned officer of ARCADIS does state as follows:

"I certify under penalty of law that I have personally examined and am familiar with the Submission and that all the information provided therein is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate, or incomplete information, and that I am committing a crime of the fourth degree if I make a written false statement that I do not believe to be true. I am also aware that, if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

ARCADIS OF NEW YORK, INC.

By: _____ 1/26/09
Robert Romagnoli, P.E. Date
Sr. Vice President

Sworn to and subscribed before me on this 26 day of January, 2009

_____
Signature of Notary Public
(Stamp and Seal/Commission Expiration Date)

LOIS A. RYFUN
NOTARY PUBLIC-STATE OF NEW YORK
No. 01RY6198427
Qualified In Madison County
My Commission Expires December 22, 2012

CERTIFICATION

Pursuant to N.J.A.C. 7:a6C-1.2

Based on the preceding Certification of Robert Romagnoli, P.E. of ARCADIS of New York, Inc. regarding the Submission (as such term is defined in that certification) each of the undersigned officers of Beazer East, Inc., Standard Chlorine Chemical Co., Inc and Tierra Solutions, Inc. does state as follows:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted herein including all attached documents, and that based on my inquiry of those individuals responsible for obtaining the information contained, to the best of my knowledge, I believe the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate, or incomplete information, and that I am committing a crime of the fourth degree if I make a written false statement that I do not believe to be true. I am also aware that, if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

BEAZER EAST, INC.

By: _____ 1-28-09
Robert Markwell — Date
Vice President

Sworn to and subscribed before me on this 28th day of JAN., 2009

_____
Signature of Notary Public
(Stamp and Seal/Commission Expiration Date)

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Donna Lee Kopach, Notary Public
City Of Pittsburgh, Allegheny County
My Commission Expires March 22, 2011
Member, Pennsylvania Association of Notaries

STANDARD CHLORINE CHEMICAL CO., INC.

By: Margaret W. Kelly January 29, 2009
Margaret W. Kelly, Esq. Date
Vice President

Sworn to and subscribed before me on this 29 day of JAN, 2009

Signature of Notary Public
(Stamp and Seal/Commission Expiration Date)

CRAIG WEXLER
NOTARY PUBLIC, STATE OF NEW YORK
Registration No. 01WE6071493
Qualified in New York County
Commission Expires March 18, 2010

TIERRA SOLUTIONS, INC.

By: _____ 1/22/09
David Rabbe
President
Date

Sworn to and subscribed before me on this 22nd day of Jan, 2009

SAMMY SALEH
NOTARY PUBLIC, State of New Jersey
My Commission Expires July 31, 2012

Sammy Saleh
Signature of Notary Public
(Stamp and Seal/Commission Expiration Date)

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Figures

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Appendices

Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
%R	percent recovery
%RSD	relative standard deviations
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
ACO	Administrative Consent Order
AVS/SEM	acid volatile sulfides/simultaneously extracted metals
BBL	Blasland, Bouck & Lee, Inc.
Beazer	Beazer East, Inc.
BERA	Baseline Ecological Risk Assessment
BSAF	biota-sediment accumulation factor
bss	below sediment surface
CAF	corrective action form
CBR	critical body residue
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLP	Contract Laboratory Program
COI	constituent of interest
COPEC	constituent of potential ecological concern

COPR	chromite ore processing residue
CSO	combined sewer overflow
CSM	conceptual site model
CVAA	cold vapor atomic absorption
Dennis	Martin Dennis Company
DGPS	Digital Global Positioning System
Diamond	Diamond Shamrock Chemicals Company
Diamond Site	former Diamond Shamrock Site
DNAPL	dense non-aqueous phase liquid
DQI	data quality indicator
DQO	data quality objective
EMPC	estimated maximum possible concentration
EPC	exposure point concentration
ESI	Environmental Standards, Inc.
FC	Facility Coordinator
ft	feet/foot
ft/sec	feet per second
GC/MS	gas chromatograph/mass spectrometry
GPS	Global Positioning System
HASP	Health and Safety Plan

HRGC/HRMS	high resolution gas chromatography/high resolution mass spectrometry
HRSA	Hackensack River Study Area
IRAW	Interim Response Action Workplan
IRM	interim remedial measure
LCS	laboratory control sample
MDL	method detection limit
MLLW	mean lower low water
MS/MSD	matrix spike/matrix spike duplicate
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
NY/NJ	New York/New Jersey
OPR	ongoing precision and recovery
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran

pH	potential of hydrogen
PID	photoionization detector
PM	Project Manager
ppt	part per trillion
PRG	Peninsula Restoration Group
QA	quality assurance
QAC	Quality Assurance Coordinator
QC	quality control
RAWP	Remedial Action Work Plan
RAWPA	Remedial Action Work Plan Addendum
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RI Report	Remedial Investigation Report
the River	Hackensack River
RIWP	Remedial Investigation Work Plan
RPD	relative percent difference
RT	retention time
SCCC	Standard Chlorine Chemical Company, Inc.
SDG	sample delivery group
Seaboard Site	former Koppers Seaboard Site

SICP	Selected Ion Current Profile
SIM	Selective Ion Monitoring
SLERA	screening-level ecological risk assessment
SM	Site Manager
SOP	standard operating procedure
SQL	sample quantitation limit
SQT	sediment quality triad
SRIWP	Supplemental Remedial Investigation Work Plan
SSP	steel sheet pile
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TEQ	toxicity equivalent
TEPH	total extractable petroleum hydrocarbon
TOC	total organic carbon
TRV	toxicity reference value
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1. Introduction

This Supplemental Remedial Investigation Work Plan (SRIWP) for the Hackensack River Study Area (HRSA) has been developed in conjunction with the remedial investigation (RI) that was conducted in 2006 for the HRSA (ARCADIS 2008). This SRIWP has been prepared in accordance with applicable regulatory requirements of the New Jersey Administrative Code (N.J.A.C.) 7:26E *et seq.* on behalf of Beazer East, Inc. (Beazer; formerly known as Koppers Company, Inc.), Standard Chlorine Chemical Company, Inc. (SCCC), and Tierra Solutions, Inc. (formerly known as Maxus Energy Corporation), collectively referred to as the Peninsula Restoration Group (PRG), or the Group. The Group is undertaking a remedial investigation/feasibility study (RI/FS) for the HRSA in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Contingency Plan, as cited in New Jersey Department of Environmental Protection (NJDEP) Field Sampling Procedures Manual, August 2005 and N.J.A.C. 7:26E *et seq*.

The technical content of this SRIWP is consistent with the Group's responses to NJDEP comments from November 2005, June 2006, and August 2008; discussions at the October 22, 2008 meeting with NJDEP and other partner agencies; and the scope of future work provided in the Remedial Investigation Report (HRSA RI Report; ARCADIS 2008).

As indicated above, this SRIWP follows N.J.A.C. 7:26-E guidelines, and also considers the following:

- Guidance for Sediment Quality Evaluations (NJDEP 1998)
- Field Sampling Procedures Manual, August 2005 (NJDEP 2005)
- Requirements for Quality Assurance Project Plans, QA/R-5 (U.S. Environmental Protection Agency [USEPA] 2001a)
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA 1997)

1.1 Objectives

The objectives of the SRIWP are to address key data gaps identified in the HRSA RI Report and to collect the data necessary to conduct a Baseline Ecological Risk

Assessment (BERA) for the HRSA. The data gaps and needs that are being addressed by this SRIWP have been divided into the following broad categories:

- Supplement the nature and extent characterization of sediments in the HRSA
- Perform regional background/reference area sampling and analysis
- Conduct a BERA investigation

Each objective is defined in detail in the data quality objectives (DQO) process in Section 3.

1.2 Site Description

The Hackensack River (the River), part of the New York/New Jersey (NY/NJ) Harbor Estuary, is located at the northeast quadrant of Newark Bay and extends north into New York State (Figure 1-1). The HRSA encompasses approximately 2.7 miles of the lower Hackensack River. The Group represents three of the upland properties abutting the HRSA: the former Koppers Seaboard Site (Seaboard Site), former Diamond Shamrock Site (Diamond Site), and SCCC, as shown on Figure 1-2. This section provides an overview of the physical characteristics of the HRSA, including channel and non-channel areas and the shoreline and hydrodynamic characteristics. A more detailed discussion of the NY/NJ Harbor Estuary and Hackensack River regional conditions has been provided in the following previous reports:

- HRSA Reconnaissance Investigation Report (Blasland, Bouck & Lee [BBL] 2005a)
- HRSA Remedial Investigation Work Plan (HRSA RIWP; BBL 2005b)
- HRSA RI Report

The operational and remedial histories of the SCCC, Diamond, and Seaboard Sites are summarized below in Section 1.3.

1.2.1 Channel and Non-channel Areas

The HRSA encompasses one U.S. Army Corps of Engineers (USACE)-defined navigation reach (Marion), along with a Turning Basin, as shown on Figure 1-2.

According to the November 1997 National Oceanic and Atmospheric Administration (NOAA) navigation chart (NOAA 1997) the Marion Reach extends approximately 2.1 miles northeast from the terminus of Droyer's Point Reach to the Turning Basin. The navigation channel is approximately 300 feet (ft) wide, with depths up to 30 ft below mean lower low water (MLLW). The Turning Basin extends approximately 1,215 ft northwest from the terminus of the Marion Reach (NOAA 1997). It ranges in width from 300 to 800 ft, with a depth 25 ft below MLLW.

Areas not classified as a channel are identified as a side channel, a near-shore region, or an intertidal mudflat (herein referred to as mudflat[s]). These areas each have slightly different bathymetric characteristics that result in hydrodynamic differences.

The side channels that neighbor the center channel are constantly submerged and have a depth up to 20 ft. The near-shore regions have a depth up to 6 ft and are tidally influenced, exposing some sections during low tide. These shallow, near-shore regions have a unique depositional pattern due to the tidal influence over this area.

The mudflats are areas along the shoreline that are approximately at the River water surface level and are also tidally influenced. These mudflats typically provide substrate for benthic organisms and foraging habitat for aquatic and terrestrial animals. Twelve mudflats of varying size, as depicted on Figure 1-2 were identified within the HRSA (BBL 2005a).

1.2.2 Shoreline

The HRSA has a diverse shoreline, ranging from heavily industrialized properties to open fields. As observed from 2002 aerial photographs acquired by Intrasearch (Englewood, Colorado), the Jersey City shoreline, located on the eastern side of the River, is an industrialized and developed area with several large buildings, oil tanks and docking areas. The Secaucus shoreline, on the eastern side of the River and north of Jersey City, is less developed and primarily consists of landfills.

As observed during the Reconnaissance Program (BBL 2005a), the western shoreline of the HRSA is predominantly composed of riprap and bulkhead structures, with only minor occurrences of vegetated sections. Conversely, the composition of the eastern shoreline was found to be more diverse, with a more even distribution of vegetated and developed sections.

Sewer systems, storm and combined sewer overflows (CSOs), and industrial outfalls serve as potential chemical constituent sources to the HRSA. Prior to the Reconnaissance Program, preliminary reviews of public records identified seven permitted outfalls within the HRSA. Each of these seven outfalls was located, described, and photographed as part of the Reconnaissance Program during a low tide event. An additional nine open pipe outfalls and four additional outfalls with tide gates were also located during the Remedial Investigation sampling, as shown on Figure 1-2.

In addition, during the Reconnaissance Program, various types of shoreline habitat for both terrestrial and aquatic animals were identified within the HRSA. These habitats include old pilings, decaying wooden bulkheads, rock piles, mudflats, and tidal marshes.

1.2.3 Hydrodynamics

The Hackensack River experiences a tidal range of approximately 5 ft. The tidal influence is responsible for the fairly high salinity levels at the mouth, but low vertical density stratification upstream. The tidal velocity at the mouth is approximately 1.9 ft per second (ft/sec; Marshall 2004, Pence 2004) and 2.6 ft/sec in the HRSA (Pence 2004). These tides bring saltwater as far upstream as the Oradell Dam.

The flow of freshwater in the Hackensack River has been reduced over time by diversion into municipal water systems. The Hackensack Water Company was created in the late 1860s to supply the cities of Hoboken, Weehawken, and Hackensack. Starting in 1901, the water company began constructing dams and reservoirs throughout the Hackensack River watershed, initially at Woodcliffe and later at Oradell and Clarkstown. These reservoirs reduced the flow of freshwater in the River, resulting in saltwater influence to move further upriver. In addition, dredging operations have allowed for more saltwater migration upriver (Marshall 2004).

Suszkowski (1978) computed that much of the freshwater in the Hackensack River is composed of discharge from wastewater treatment facilities. Additionally, the Hackensack River remains the receiving surface water body for multiple industrial and municipal discharges as well as stormwater runoff. Multiple well-known potential current and historical sources of contamination exist along the Hackensack River -- upstream, downstream, and within the HRSA where the PRG sites are located.

1.3 Site History

The operational histories and remedial measures implemented for the three upland properties that constitute most of the Kearny Peninsula of the lower Hackensack River are briefly described in the following subsections. More detailed discussions have been provided in the previous HRSA reports listed in Section 1.2.

1.3.1 Standard Chlorine Chemical Company Site

The SCCC Site occupies approximately 25 acres; the western two-thirds of the site contained the plant manufacturing facilities and the eastern third contained an unlined lagoon system. Manufacturing operations were conducted on portions of the SCCC Site between 1916 and 1993 by various entities, including the White Tar Company (1916-1933), Koppers Company, Inc. (1933-1962), Standard Naphthalene Products Co., Inc. (1962-1980), SCCC, Inc. (1962-1981) and Cloroben Chemical Corporation (1962-1993). Operations included refining naphthalenes; manufacturing products from naphthalene, naphthalene derivatives, and dichlorobenzenes; formulating drain cleaning products; and, on a limited basis during the 1970s, processing trichlorobenzene (Key Environmental, Inc. 2004). Fill materials were placed at the SCCC Site during the 1920s and 1930s to create additional land for industrial development. These fill materials generally consisted of chromite ore processing residue (COPR) soils and silty sand. COPR soils were placed as fill on approximately 85 percent of the SCCC Site to depths ranging between 2 and 10 ft below the present grade (Roy F. Weston, Inc. 1993).

A series of interim remedial measures (IRMs) were implemented by SCCC between 1990 and 2000 and included placement of geotextile and riprap along the Hackensack River shoreline in the vicinity of the lagoon, placement of a geotextile fabric with 4 inches of underlying dense graded aggregate and 4 inches of overlying asphalt over traffic areas, and constructing a surface cover with geotextile/geomembrane liner overlain with 4 inches of dense graded aggregate.

An Interim Response Action Workplan (IRAW) was submitted for the SCCC Site in March 2004. The NJDEP issued comments to the IRAW in April 2006 and a revised IRAW was submitted in June 2006. The NJDEP issued comments on the June 2006 IRAW on April 11, 2007. A revised IRAW incorporating NJDEP comments was submitted in May 2007 by the Group (Key Environmental, Inc. 2007a). Comments on this version of the IRAW were issued by NJDEP on October 5, 2007. A response letter with an IRAW Addendum was submitted by the Group on November 16, 2007. NJDEP

issued approval of the IRAW on March 27, 2008. In order to consolidate the May 2007 IRAW and the November 2007 Addendum, a final IRAW was prepared and submitted to NJDEP by the Group on October 17, 2008. Proposed interim responses included the following:

- Installation of a perimeter barrier wall system
- Hydraulic control (groundwater collection and treatment) within the containment
- Removal and on-site consolidation of Hackensack River sediments located within 50 ft of the proposed barrier wall
- Installation of a dense non-aqueous phase liquid (DNAPL) recovery system
- Installation of a surface cover system over the lagoon contents and adjacent areas not previously address by the chromium IRMs

1.3.2 Former Diamond Shamrock Site

A chromate chemical manufacturing facility on the Diamond Site was constructed in 1916 by the Martin Dennis Company (Dennis). The facility imported chromite ore for use in the production of sodium bichromate for retail sale or use in manufacturing other chromium chemicals. In 1952, the facility also began producing chrome-based leather tanning agents called “Tanolin” and chromic acid. The production of sodium bichromate by Dennis and, subsequently, Diamond—who purchased the site in 1948—continued until November 1971. Production of Tanolin and chromic acid continued until 1976, when all production at the facility was discontinued. The majority of the buildings were razed in 1978 (Brown and Caldwell 2001a; 2001b).

A series of IRMs were implemented at the Diamond Site between 1990 and 2000 which included placement of a geotextile fabric/geomembrane liner composite and overlying riprap, 4 inches of overlying dense graded aggregate, and a 2- to 4-inch-thick layer of asphalt over the existing soils and pavement. Components of the IRAW for the Diamond Site are an extension of those proposed for the SCCC Site, as described previously, including the installation of a perimeter barrier wall system, hydraulic control (groundwater collection and treatment) within the containment, and removal of Hackensack River sediments located within 50 ft of the proposed barrier wall (including sediment along Mudflat 11).

1.3.3 Former Koppers Seaboard Site

The Seaboard Site is the location of a former integrated coke plant, tar plant, and coke byproducts facility, and is currently owned by the Hudson County Improvement Authority. The Seaboard Site occupies approximately 174 acres, with 131 of those located above the mean high water level. The Seaboard Site is being addressed in accordance with a March 1986 Administrative Consent Order (ACO) between Koppers Company (now Beazer) and NJDEP.

The site can be divided into two areas: the eastern and western portions. The eastern area of the property includes the former coal tar processing plant, former coke plant and the former coal/coke storage area. Coal tar distillation and coking operations were conducted in proximity to the Hackensack River, in the northeast and southeast sections of the property, respectively. The western area of the site includes the former light oil residue area, spent oxide deposit area and former coke/coal storage area (Key Environmental, Inc. 1998).

SK Services prepared and submitted a Remedial Action Work Plan (RAWP) for the Seaboard Site Remedy (Key Environmental, Inc. 1998) and the NJDEP approved the RAWP in May 1998. Following approval of the RAWP, the following activities were conducted:

- Installed the sheet pile barrier wall and partially installed the processed dredged material Key barrier
- Installed a significant portion of the surface cover
- Consolidated a portion of the on-site waste materials
- Continued to operate the interim measures DNAPL recovery system
- Conducted long-term monitoring of natural attenuation of constituents of interest (COIs) in groundwater
- Removed and disposed off site the contents (tar and naphthalene) of a 1,000,000-gallon aboveground storage tank and the tank itself
- Located and closed two deep groundwater production wells on site

In addition, work on the deed restrictions was initiated. Following SK Services' bankruptcy and its failure to win additional dredging contracts, some RAWP remedial components remain to be completed, consisting of approximately 30 percent of the originally planned RAWP work.

As a result of continuing discussions with the NJDEP, Beazer submitted a RAWP Addendum (RAWPA) for the Seaboard Site in March 2007 (Key Environmental, Inc. 2007b). The March 2007 RAWPA outlined planned supplemental investigations and remedial responses for the Seaboard Site. Supplemental investigation activities included collecting sediment characterization data for near-shore Hackensack River sediments. Planned remedial responses consisted of completing a barrier wall system inboard of the existing steel sheet pile (SSP) barrier wall, consolidation and on-site management of target materials including on-site materials and near-shore sediments (i.e., those located within 50 ft of the existing SSP barrier wall), installation of an in-situ permeable treatment system to enhance natural attenuation, upgrading the existing non-aqueous phase liquid recovery system installed as an IRM, and installation of a surface cover system consisting of processed dredged material. The Final RAWPA was approved by the NJDEP on August 10, 2007. Implementation of the Final RAWPA was initiated in April 2008 and is currently ongoing.

1.4 Work Plan Organization

This SRIWP has been generally structured in accordance with USEPA QA/R-5 Guidance (USEPA 2001a), which is referenced in Chapter 2 of the Field Sampling Procedures Manual (NJDEP 2005). This guidance provides a tool for documenting the type and quality of data needed to make informed environmental decisions and serves to integrate the technical and quality aspects of a typical RI including planning, implementation, assessment, reporting, and quality improvement. Table 1-1 provides a cross-reference between the QA/R-5 and the contents of this SRIWP to confirm that QA/R-5 elements have been accounted for.

In addition, as required by N.J.A.C. 7:26E – Technical Requirements for Site Remediation (N.J.A.C. 2002), the following components have been integrated into this document:

- Historical and current site information (Sections 1 and 2)
- DQOs utilized to establish the sampling program (Section 3)

- Field Sampling Plan and proposed sampling locations (Section 4)
- A description of the role of principal personnel who will participate in the program (Section 5)
- Components of a Quality Assurance Project Plan (QAPP), which describe the measures to be taken to provide quality assurance (QA) and maintain quality control (QC) during the work (Sections 6 through 9)
- The anticipated deliverable following completion of the field sampling and analytical programs (Section 10)
- An estimated schedule for sampling activities (Section 11)

Together, these elements cover the proposed field and analytical work, from program design to data management and control. Additionally, the field and laboratory standard operating procedures (SOPs) are presented in Appendices A and B, respectively. The quality assurance manuals for each laboratory are presented in Appendix C. The final SRIWP element, the Health and Safety Plan (HASP), is provided as Appendix D.

2. Summary of Previous Investigations

The following sections summarize previous investigations implemented by the Group along the HRSA including the Reconnaissance Investigation Report and the HRSA RI Report, which included the screening-level ecological risk assessment (SLERA).

2.1 Reconnaissance Report

The HRSA Reconnaissance Program, which served as a precursor to the RI, occurred between November 2004 and May 2005, and consisted of the following three tasks:

Task 1 — Data Compilation and Review

Task 2 — Collection of Field Data and Information

Task 3 — Source Identification

A Reconnaissance Investigation Report for the Hackensack River Study Area was submitted to NJDEP on May 25, 2005, detailing the findings of the study (BBL 2005a). In general, Task 1 consisted of collecting and reviewing historical literature (including pertinent data) that described and/or quantified various features of the River. This task assisted in focusing the reconnaissance effort, and was useful in designing the approved HRSA RIWP. Approximately 260 documents containing historical data and information were collected at that time. This database continues to be updated as additional materials are collected.

Task 2 included implementing a field-based investigation that was meant to characterize HRSA physical features, such as water depths, soft sediment depths, and ecological habitat. Information pertaining to river depth and morphology were collected from the bathymetric survey data, while side-scan sonar data were used to characterize the surficial textures of the riverbed and identify potential debris. Soft sediment depths were determined by physically probing along 30 transects spaced 500 ft apart throughout the HRSA. These probing depths were useful in designing the number and location of cores collected as part of the RI.

During this investigation, both sides of the shoreline were inspected by boat during high and low tides. During high tide, observations were made of types of shoreline stabilization, adjacent land use and vegetation at and above the high tide line. Observations of mudflats, habitat, outfalls, and other pertinent features were also

made, where possible. Mudflat locations and length, intertidal and shoreline vegetation, depositional characteristics, wildlife observations, and outfalls/discharge points were documented during low tide.

Task 3 centered on identifying potential sources to the HRSA including, but not limited to, permitted and unpermitted direct or indirect dischargers, potential groundwater discharges, publicly owned treatment works, stormwater outfalls, and CSOs. This final task was initiated as part of the Reconnaissance Program and is currently ongoing.

2.2 Remedial Investigation Report

The RI Program was implemented to evaluate the preliminary nature and extent of constituents in sediments of the HRSA and to conduct a SLERA, which is further described in Section 2.2.1 below. Under the RI program, sediment samples were collected during the fall of 2006. A total of 37 cores were collected along 15 transects spaced approximately 1,000 ft apart. The target depth of the sediment cores varied from 2 to 12 ft based on sediment thickness information obtained during the Reconnaissance Program. In addition, 19 shallow cores (top 6 inches) were collected from 6 of the 12 mudflats identified as part of the Reconnaissance Program.

A total of 199 sediment samples were collected from the sediment cores and mudflat samples: 132 for chemical and physical analysis and 67 for radiochemical analysis. Parameters analyzed included pesticides, Aroclor polychlorinated biphenyls (PCBs), semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), target analyte list (TAL) metals, cyanide, acid volatile sulfides/simultaneously extracted metals (AVS/SEM), hexavalent chromium, PCB congeners, chlorinated herbicides, polychlorinated dibenzodioxins (PCDDs) / polychlorinated dibenzofurans (PCDFs), total extractable petroleum hydrocarbon (TEPH), radiochemistry, and physical parameters.

The results of the analyses were presented in the HRSA RI Report. In addition, the HRSA RI Report characterized the distributions of regional COIs in the HRSA. The list of regional COIs was developed from the operational and remedial histories presented for each site, as well as from historical knowledge of the surrounding water bodies.

COIs detected at the highest frequency (greater than 90 percent of samples) included mercury, lead, total chromium, total PCBs, and TEPH. Additional COIs detected at a high frequency (50 to 90 percent of samples) included naphthalene, total polycyclic aromatic hydrocarbons (PAHs), total DDT, and 2,3,7,8-tetrachlorodibenzo-p-dioxin

(2,3,7,8-TCDD). Despite the frequency of detection, the high variability of detected inorganic compounds, naphthalene, PAHs, PCBs, and TEPH among in-river and mudflat sediment samples precluded conclusions regarding detailed spatial trends and/or gradients. Four general observations could be made: 1) sediments obtained from cores located in the southern section of the HRSA contained higher concentrations of COIs than those in the northern HRSA; 2) sediments obtained from cores located closer to shore contained higher concentrations of COIs than those farther from shore ; 3) higher mean concentrations of COIs were detected in the upper 2 ft (generally in the top 6 inches) of sediment, with mean concentrations generally decreasing with depth; and 4) high variability among detected concentrations of COIs in samples collected precludes any conclusions regarding spatial trends and/or gradients in the in-River and mudflat samples. A notable exception was found at Core 005, where higher concentrations were observed at depth than in surficial sediments.

2.2.1 Screening-level Ecological Risk Assessment

Per applicable USEPA (1997) and NJDEP (1998) guidance and regulatory requirements, a SLERA was conducted as part of the RI to assess the need and level of effort necessary to conduct a more detailed BERA. A conservative screening process was used to determine which chemical constituents could potentially pose risks to ecological receptors (USEPA 2001b).

Because there were no available data on chemical constituents for organisms within the food web in the HRSA, it was not possible to estimate bioaccumulative risks. Therefore, the risk characterization for the SLERA was based solely on the results of a conservative sediment screening process, which established a list of constituents of potential ecological concern (COPECs) based both on direct toxicity (i.e., direct exposure to sediments) and indirect exposure (i.e., ingestion of prey in the food web, potentially resulting in bioaccumulation/biomagnification). A total of 18 inorganic compounds, dioxin/furans (assessed collectively as 2,3,7,8-TCDD toxicity equivalents [TEQs]), PCBs (assessed as total PCBs and 2,3,7,8-TCDD TEQs), 18 pesticides, 26 SVOCs (including 18 PAHs), and five VOCs were identified as COPECs in sediment for the HRSA.

The results of the SLERA indicated that sufficient sediment data and information exist to demonstrate that constituents are present in sediments within potential habitats of the HRSA that may be used by various ecological receptors (benthic and epibenthic invertebrates, fish, birds, and mammals), and ecological risks cannot be ruled out for many of these constituents, which were identified as COPECs. However, the lack of

bioaccumulation data for organisms in the food web of the HRSA limited the ability of the SLERA to screen for potential risks from bioaccumulation/biomagnification in the food web via the ingestion pathway. As a result, it was concluded that a BERA is needed for the HRSA to evaluate risks that might be posed by the COPECs identified in the SLERA.

2.2.2 Conceptual Site Model

The conceptual site model (CSM) was identified as part of the RI and SLERA. The physical setting, site history, demography and land use characteristics of the HRSA are described Section 2 of the HRSA RI Report and are described in greater detail in the approved HRSA RIWP. Section 2 of the HRSA RI Report also provides additional detail on the hydrodynamics and ecology of the HRSA as they relate to the development of the CSM, which is further described in Section 5 of the HRSA RI Report. A graphical presentation of the HRSA CSM is presented in Figure 2-1. The CSM demonstrates how organisms at various levels of the food web may be exposed to COPECs in the HRSA. The CSM will be refined pending results of the additional nature and extent investigation and BERA activities proposed in this SRIWP.

3. Sampling Program Design

The NJDEP Field Sampling Procedure Manual (NJDEP 2005) describes the process for creating a sampling plan utilizing USEPA's Data Quality Objectives Process for Hazardous Waste Site Investigations (USEPA 2000a). This USEPA document provides a seven-step DQO process useful in designing sampling programs. Questions fundamental to formulating project-specific DQOs include:

Step 1 - What problems will be studied and what are the objectives of the project?

Step 2 - What specific decisions must be made or questions resolved on the basis of the data to be collected?

Step 3 - What types of data are required, how are the data to be obtained and managed, and how will they be used?

Step 4 - What are the spatial limits and what are the temporal limits?

Step 5 - How will the data, once collected, be synthesized and interpreted to make a decision?

Step 6 - Specify tolerance limits on decision error - what are the acceptable performance limits and constraints that will limit performance?

Step 7 - Optimize the design for obtaining data - what is the optimum approach in terms of the cost-benefit ratio for meeting DQOs?

The DQO process for this SRIWP is outlined in the following section.

3.1 Data Quality Objectives

3.1.1 DQO Step 1 – State the Problem

Section 1 of this SRIWP identifies the objectives of this sampling program. As described, the work is being conducted to fulfill the following data needs:

- Supplemental nature and extent characterization

- Regional background/reference area sampling
- BERA investigation

3.1.2 DQO Step 2 – Identify the Decision

In consideration of the requirements of NJDEP and the Group, the program will focus on specific objectives that, when addressed, will lead to a more complete understanding of the nature and extent, and potential risks posed by chemical constituents in HRSA sediment. Each objective is defined below.

Supplemental Nature and Extent Characterization

As part of the RI Program, analytical data were collected from within numerous sediment pockets located throughout the HRSA. The focus of the work was to assess the preliminary horizontal and vertical distribution of specific contaminants. While these data provided sufficient information to preliminarily characterize HRSA sediments, the collection of additional data will allow for a more refined trend analysis, and will better reflect contaminant gradients from the three sites. The additional data will also supplement the existing dataset for the BERA.

More specifically, the nature and extent data gaps identified include the need for:

- Further delineation where oil-like substances were observed in sediments along one of the three sites
- Additional constituent data in deep sediments at Core location 005
- Additional constituent data from select locations adjacent to the three sites to further evaluate COI distribution in sediment
- Additional constituent data from surface sediments in mudflats not sampled as part of the initial RI Program (collected as part of the BERA)

Regional Background/Reference Area Sampling

To understand the context of the HRSA in relation to the larger Hackensack River system, it is important to characterize regional background conditions. While some downstream data currently exist, additional sampling in the upstream area will help to

further refine this assessment. These additional data will also provide information for the BERA to help differentiate site-specific risks from regional background risks.

Baseline Ecological Risk Assessment

Pursuant to NJDEP and USEPA risk assessment guidance, a BERA is necessary to assess whether the COPECs identified in the SLERA may be adversely affecting ecological receptors that reside in or utilize the HRSA. The BERA will evaluate incremental risks potentially associated with the sites, relative to the urban background conditions, and will consider risks that may be attributable to other known sources of contaminants. As demonstrated in the SLERA, there is only a limited amount of risk-based data available for the HRSA. The primary data gaps that need to be addressed to complete the BERA include:

- A habitat characterization that takes into account a larger portion of the adjacent wetlands/uplands of the HRSA than was previously characterized in the Reconnaissance Investigation Report
- Surface sediment chemistry data in the HRSA mudflats (not previously sampled or remediated) and adjacent subtidal areas
- Benthic invertebrate community data
- Sediment toxicity data for benthic invertebrates
- Tissue data from various species of fish and shellfish at different trophic levels in the food web
- Comparable data in select background/reference locations upstream from the HRSA

As part of the HRSA RI Program, analytical data were collected from the top 6 inches of sediment. While these data provided sufficient information for the SLERA and for characterizing sediment quality along the HRSA, additional surface sediment samples are needed in conjunction with toxicity testing and benthic community analysis to assess risks to benthic invertebrates through a sediment quality triad (SQT) approach. Surface sediment data are also needed to evaluate bioaccumulation relationships between sediment COPECs and fish/shellfish. In addition, tissue data from food web organisms are needed to assess potential risks

to aquatic organisms, birds, and mammals. Because no data exist for chemical concentrations in any portion of the food web in the HRSA, fish and shellfish (i.e., crab) tissue data need to be collected to determine these potential risks.

3.1.3 DQO Step 3 – Identify Inputs to the Decision

The following data and information were used in designing the Supplemental RI Sampling Program:

- Data summarized in the HRSA RI Report regarding the physical, chemical, and geotechnical properties of the HRSA sediments
- Results of the SLERA including the known food web of the HRSA and those constituents identified as COPECs
- Historical bathymetric records, including those related to dredging, infilling, and other anthropogenic activities that may influence bathymetry
- Historical and current studies of sediment transport and deposition within the HRSA
- Historical and current hydrologic and hydrodynamic data, including river flow and tide data
- Historical and current data and information on the ecological habitats and conditions in the HRSA
- The CSM for the HRSA

In combination with the data that are ultimately collected by this program, this information will be valuable in establishing current conditions of the HRSA and addressing data gaps.

3.1.4 DQO Step 4 – Define the Study Boundaries

The HRSA consists of a 2.7-mile portion of the River (Figure 1-2). As shown in Figure 1-2, the area extends from one-half mile upstream of the Diamond Site, to one-half mile downstream of the Seaboard Site.

The vertical boundaries for this sampling effort extend to a maximum depth of 20 ft. Depth determinations were generally developed based on sediment thicknesses obtained as part of the RI and Reconnaissance Programs.

3.1.5 DQO Step 5 – Develop a Decision Rule

The following questions present the decision rules that will be used to meet the objectives presented in Step 2.

Supplemental Nature and Extent Characterization

- What is the nature and extent of chemical constituents in sediments in the HRSA?
- What is the nature and extent of oil-like substances in sediments along an area near one of the sites?

Regional Background/Reference Area Sampling

- What is the distribution of chemical constituents in sediments and biological tissue in the regional background/reference area?
- What is the magnitude of current ecological risks, if any, present in the regional background/reference area?

Baseline Ecological Risk Assessment

- What is the extent of chemical constituents in surface sediment and biological tissue of the food web in the HRSA?
- What are the potential current ecological risks posed by COPECs in the HRSA?
- Are the current potential ecological risks present in the HRSA elevated when compared to background risks?
- Do the potential ecological risks in the HRSA warrant the site to be further evaluated in a Feasibility Study?

3.1.6 DQO Step 6 – Specify Limits on Decision Errors

The sampling design should strive to identify possible sources of error and minimize them, to the extent practical. Several types of errors may be encountered in the sampling program and during the BERA process; each is described below.

Sediment and Tissue Sampling and Analysis

Measurement errors are the result of imperfection inherent in the measurement and analysis of the samples. Both random and systematic errors can be introduced during the physical collection of the sample, sample handling and analysis, and data handling.

Errors introduced during these steps will be controlled by preparing and following SOPs and establishing appropriate controls for data quality (as outlined in Section 7). These controls apply to field procedures (e.g., adherence to SOPs, field equipment calibration, equipment, field duplicates), laboratory analytical errors (e.g., calibration standard, interval standard and surrogate recoveries, laboratory control sample [LCS]), and data validation.

Sample design error is the result of the inherent variability of the sampled population over space and time, sample collection design, and the number of samples available upon which to base the decision. Because it is impossible to sample every inch of the River, there is always a possibility that some feature of the natural variability is missed. Sampling design error can increase the chance for misrepresenting the natural variability by random error (imprecision) or systematic error (bias) in sampling.

As the number of samples controls how well the population is characterized, use of the DQO process requires that the variability of data be understood to evaluate the trade-off between uncertainty (confidence limit) and sampling intensity. Additionally, the sampling has been segregated into various regions based on geomorphic areas to address part of the inherent variability present in the Hackensack River. This stratification will reduce the overall unexplained variability in the data and increase the power of subsequent statistical analysis.

BERA

A number of potential decision errors can be made in the risk assessment process due to the subjective nature and high uncertainty associated with the risk paradigm (USEPA 1998). Sources of uncertainty are encountered throughout the risk assessment process and can include variability and uncertainty about a quantity's true value. All risk assessments involve substantial sources of uncertainty and oftentimes uncertainties from different sources are compounded. The quality of a risk assessment is determined by the extent to which the uncertainties are recognized and dealt with in a comprehensive, transparent, and repeatable manner.

Variability and uncertainty about a quantity's true value contribute to decision errors when estimating the value of a parameter. Examples of variability include organic carbon data, seasonal differences in an organism's diet, or differences in toxicity among different species. Variability is described by presenting a distribution or specific percentiles from it (e.g., mean, 95th percentile). Similarly, to quantify uncertainty about a quantity's true value, standard statistical methods are used to construct probability distributions or point estimates (e.g., confidence limits; USEPA 1998).

The uncertainty and variability in the BERA will be minimized through site-specific data collection that includes adequate sample representation (i.e., key food web organisms at different trophic levels, paired sediment/toxicity/benthic community data from each sampling location, spatial diversity among sampling locations within the HRSA); reasonable sample replication and controls; QA/QC of sample collection, processing, and analyses; and non-biased statistical analyses of the resulting data. Quantitative and qualitative uncertainty analyses will be conducted and presented in detail in the BERA. These steps will minimize the effects of uncertainties on the results and conclusions of the risk assessment.

3.1.7 DQO Step 7 – Optimize the Design for Obtaining Data

Based on Steps 1 through 6, the Supplemental RI Program for the HRSA was developed to generate data expected to satisfy the DQOs and overall goals of the project. The following section presents the scope of work for each task. In addition, Table 3-1 summarizes the proposed scope and associated data uses.

3.2 Investigation Approach

The following provides an overview of the work to be conducted for the SRIWP as it relates to the DQOs.

3.2.1 Supplemental Nature and Extent Sampling

To further evaluate the nature and extent of COPECs in the HRSA (including assessing gradients from sites), sediment cores will be advanced along the western site of sites. Sediment thickness information obtained during the Reconnaissance and RI Programs has been used to locate these cores. Sediment samples will be collected from the cores using the same segmentation scheme as was used in the 2006 RI Sampling Program. In addition, one deep core will be collected at former RI Core 005 to vertically delineate the extent of COPECs at that location.

Surface sediment grab samples will be collected from mudflats not sampled as part of the RI Program. Mudflat 8 has been removed as part of the near shore sediment removal action on-going at the Seaboard site; therefore, this mudflat will not be included in this investigation program. Surface sediment sampling will be conducted as part of the BERA discussed in Section 3.2.3.2.

To evaluate the extent of oil-like substances observed in sediments in the vicinity of one of the three sites during the 2006 RI Sampling Program, sediment cores will be collected near RI Cores 011 and 012 (Transect 11) and Core 013 (Transect 13). Sediment cores will not be advanced near Core 006 (where oil-like substance was observed in the southern HRSA) because delineation in this area was completed by PSE&G during the investigation of the Former West End Gas Works site. Cores will be collected in an approximate 100-ft grid pattern and visually assessed for the presence/absence of oil-like substances. Samples may then be collected for analysis of PAHs, TEPH, and total organic carbon (TOC) to delineate and/or further characterize oil-like substance in sediment.

3.2.2 Regional Background/Reference Area Sampling

To assess regional background conditions, the literature review completed as part of the Reconnaissance Investigation Report will be updated; a literature search to identify sediment quality data outside the HRSA will be completed; and one or more suitable background/reference areas will be selected from the upstream area, as well as from the downstream area, if necessary.

Anticipated background/reference areas include upstream in-river (i.e., subtidal) and mudflat locations and will be selected at locations away from known current and historical sources, such as industrial facilities/activities and storm/sanitary discharges. Concentrations of COPECs in background locations will be compared to COPEC concentrations in samples from the HRSA. In addition, potential ecological risks in the background area will be evaluated relative to potential ecological risks in the HRSA.

3.2.3 Baseline Ecological Risk Assessment

The following section outlines the general approach for conducting the sampling required to complete the BERA. It also describes how the risk assessment will be conducted after the data are collected and analyzed. The BERA process follows guidelines provided by NJDEP (1998) and USEPA (1997) and includes an exposure and effects evaluation and a risk characterization.

3.2.3.1 Shoreline Habitat Characterization

Although a shoreline habitat characterization was previously conducted during the Reconnaissance Investigation, a more extensive characterization of the HRSA shoreline will be conducted for the BERA. This will include biological surveys and characterization of the shoreline beyond 100 ft from the River's edge. These data will provide key information on population integrity and habitat diversity for species residing in or utilizing the HRSA.

3.2.3.2 Sediment and Tissue Data Collection

The BERA will utilize a combination of existing/historical data, as well as new data that will be collected. Surface sediment samples will be collected in conjunction with sediment toxicity testing and benthic community data to assess risks to benthic invertebrates through an SQT assessment. Surface sediment data are also needed to evaluate bioaccumulation relationships between sediment COPECs and fish/shellfish. Data will also be collected to assess risks to the key groups of organisms that comprise the food web of the HRSA, as identified in the Reconnaissance Investigation Report and HRSA RI Report:

- Primary consumers – benthic invertebrates
- Omnivorous crustaceans – e.g., blue crab (*Callinectes sapidus*)

- Forage fish – e.g., mummichog (*Fundulus heteroclitus*)
- Predatory fish – e.g., striped bass (*Morone saxatilis*), white perch (*Morone americana*)
- Piscivorous birds – e.g., herons and egrets (Family Ardeidae), belted kingfisher (*Ceryle alcyon*)
- Piscivorous mammals – e.g., mink (*Neovison vison)* or river otter (*Lontra Canadensis)*

The focused data collection program will be designed to synoptically collect data from intertidal (mudflat and associated wetland fringes) and subtidal areas of the HRSA to address ecological risks to these organisms via three general categories:

- SQT assessment to determine risks to benthic invertebrates and bioavailability of COPECs from sediment to the food web
- Forage fish (e.g., mummichog [*Fundulus heteroclitus*]) tissue data at the mudflat SQT sampling locations to evaluate bioaccumulation/risk for localized fish populations, and to assess risks to populations of upper-trophic level fish and piscivorous birds and mammals that feed on these organisms
- Resident and migratory fish and shellfish (e.g., blue crab) tissue samples with varying feeding guilds to assess risks to populations of these organisms, as well as piscivorous birds and mammals that utilize the system and feed on these organisms

The tissue and sediment data collected from the HRSA will be compared to sediment and tissue data collected in the background/reference area as well as tissue data for similar species from the Newark Bay Estuary to determine any apparent differences among the datasets. In addition, biota-sediment accumulation factors (BSAFs) will be calculated to assess the potential for uptake of contaminants from the sediment into fish tissue. The tissue data will also be used to construct and run wildlife food web exposure models for birds and mammals.

3.2.3.3 Assessment and Measurement Endpoints

Together, the sediment and fish/shellfish tissue data collected, along with the existing/historical data and a more extensive habitat characterization along the shoreline, will provide a basic set of information that can be used to fulfill the risk assessment requirements under New Jersey and USEPA guidelines. Specifically, these data will be used to address each assessment endpoint identified in the problem formulation phase of the SLERA. Several detailed measurement endpoints are proposed below to demonstrate how the sediment and tissue data will be specifically used to assess ecological risk in the HRSA.

- Survival and maintenance of a normally functioning benthic invertebrate community
  - o Compare sediment COPEC concentrations to toxicity-based screening values
  - o Conduct laboratory chronic toxicity bioassays with *Leptocheirus plumulosus* using HRSA, background, and reference control sediment and statistically compare the biological responses
  - o Conduct benthic community analysis and use multi-metric or multivariate statistical techniques to compare to reference datasets
  - o Evaluate any statistically significant relationships between sediment data and the results of toxicity tests and benthic community metrics
- Survival and maintenance of normal reproducing populations of epibenthic invertebrates (e.g., crustaceans, shrimp)
  - o Compare COPEC concentrations in blue crab (*Callinectes sapidus*) and/or other tissue samples to literature-based critical body residue (CBR) data
- Survival and maintenance of normal reproducing populations of fish – e.g., mummichog (*Fundulus heteroclitus)*, white perch (*Morone americana*), Atlantic menhaden (*Brevoortia tyrannus*), striped bass (*Morone saxatilis*)
  - o Compare COPEC concentrations from fish tissue to literature-based CBR data
  - o Document gross and/or histopathological lesions in fish

- Survival and maintenance of normal reproducing populations of piscivorous birds – e.g., wading birds (herons, egrets [Family Ardeidae]) and/or belted kingfisher (*Ceryle alcyon)*

  - Run food web dose models using sediment chemistry data, prey species (i.e., mummichog) tissue data and compare results to literature-based toxicity reference values (TRVs)

- Survival and maintenance of normal reproducing populations of piscivorous mammals – e.g., mink (*Neovison vison)* or river otter (*Lontra Canadensis)*

  - Run food web dose models using sediment chemistry data, prey species (i.e., mummichog, blue crab) tissue data and compare results to literature-based TRVs

3.2.3.4 Exposure and Effects Assessment

Risk is a function of exposure and toxicity. The exposure analysis of the BERA consists of characterizing the receptors and exposure pathways within the HRSA (including estimates of areal and seasonal use factors for migratory or semi-migratory species), and determining the exposure point concentrations (EPCs) for each environmental exposure medium (i.e., sediment and biological tissue). The effects evaluation focuses on establishing thresholds that are potentially indicative of ecological effects for each of these media. The EPCs are then compared to the appropriate ecotoxicity threshold values (i.e., CBRs and TRVs) to evaluate ecological effects. The following sections describe how the EPCs will be calculated and how the sediment and biological tissue threshold toxicity values will be compiled.

<u>Exposure Point Concentrations</u>

Estimates of chemical concentrations at points of potential exposure are necessary to evaluate chemical intake by potentially exposed receptors. USEPA (1989a) guidance uses an average concentration to represent a reasonable estimate of the concentration likely to be contacted over time and recommends that the 95 percent upper confidence limit (95 percent UCL) on the average be used because of the uncertainty associated with estimating the true average concentration at a site.

The EPCs for each COPEC detected in greater than 10 percent of the samples will be calculated following guidance provided by USEPA (2002a) using the ProUCL

software package (Version 4.0) developed by USEPA (2007). The EPC will be evaluated as the 95 percent UCL, the maximum, and distributions of concentrations detected at the site for the various sediment and tissue datasets. This approach is most reasonable in evaluating potential risks, and in characterizing the uncertainties associated with and the variability of the data and risk results from a site.

Sediment Quality Guidelines

Sediment EPCs will be compared to existing sediment quality guidelines as set forth by NJDEP, NOAA, USEPA, or other regulatory agencies, including but not limited to, the following:

- NJDEP Ecological Screening Criteria (ESC) Table. Updated July 2008. Available: http://www.nj.gov/dep/srp/guidance/ecoscreening/

- NOAA Screening Quick Reference Tables (SQuiRT). 2008. NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, 34 pp

- Swartz. 1999. Consensus Sediment Quality Guidelines for Polycyclic Aromatic Hydrocarbon Mixtures. *Environmental Toxicology and Chemistry* 18(4):780-787

- MacDonald et al. 2000. Development and evaluation of consensus-based sediment effect concentrations for polychlorinated biphenyls. *Environmental Toxicology and Chemistry* 19(5):1403-1413

As prescribed by N.J.A.C. 7:26E-3.11 and NJDEP (1998) the following references will also be utilized:

- Long et al. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environmental Management* 19:81-97

- USEPA. 1989b. Briefing Report to the EPA Science Advisory Board on the Equilibrium Partitioning Approach to Generate Sediment Quality Criteria, EPA 440/5-89-002. Office of Water, Washington D.C., 154 pp

- MacDonald et al. 1992. The development of Canadian marine environmental quality guidelines. Marine environmental quality series no. 1. Environment Canada Ecosystem Sciences and Evaluation Directorate, Ottawa. 121 pp

Critical Body Residue Data

A chemical residue approach, termed a CBR, is used to evaluate potential risks posed by COPECs to fish and large macroinvertebrates (e.g., blue crab). The CBR method relies on the identification of whole body concentrations of a chemical that have been demonstrated to be associated with adverse effects on a target organ or system in a variety of aquatic organisms or phylogenetic groups. A CBR is a contaminant- and taxon-specific threshold concentration measured in biological tissue above which adverse effects of ecological relevance would be anticipated to occur based on one or more studies that have been conducted in the field or laboratory. When data do not exist for a particular receptor of interest, or the data for that receptor are deemed inadequate for risk assessment purposes, then surrogate CBR data can be used from related or similar taxonomic organisms. Generally the CBR-based effects are measured based on mortality or reproduction endpoints which are the most relevant for estimating the potential for adverse population-level effects. CBR data for the HRSA BERA will be obtained from relevant literatures sources and databases including, but not limited to the following:

- USACE and USEPA Environmental Residue-Effects Database (ERED; USACE/USEPA 2003), available online: http://el.erdc.usace.army.mil/ered
- Handbook of Chemical Assessment: Health Hazards to Humans, Plants, and Animals (Eisler 2000)
- Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations (Beyer et al. 1996)
- Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals (Jarvinen and Ankley 1999)
- Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment: Status and Needs (USEPA 2000b)
- Other literature sources as needed

For bioaccumulative, organic compounds for which CBRs are not currently available or are not of sufficient quality, CBRs may be developed based on quantitative

structure activity relationships. McCarty and Mackay (1993) compiled a list of estimated residues for various compounds and effect classes.

Toxicity Reference Values

Tissue thresholds for upper-trophic level organisms such as birds and mammals are referred to as TRVs. A TRV is defined as a dose level (based on laboratory toxicological investigations) above which a particular ecologically relevant effect may be expected to occur in an organism following chronic dietary exposure, and below which it is reasonably expected that such effects will not occur (USEPA 2005). Rather than deriving a single point-estimate associated with specific adverse biological effects, both high and low TRVs are derived for each wildlife receptor and each COPEC to bracket the effect threshold level. The low TRV is a conservative value consistent with a chronic no observed adverse effects level. It represents a level at which adverse effects are unlikely to occur, and is used to identify sites posing little or no risk. Conversely, the high TRV is a less conservative estimator of potential adverse effects, representing a level at which adverse effects are more likely to occur, and is consistent with a chronic lowest observed adverse effects level.

TRVs will be compiled from available literature sources and databases including, but not limited to, the above mentioned for CBRs as well as the following additional sources:

- Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al. 1996)
- TRVs derived for the USEPA Ecological Soil Screening Level documents (USEPA 2005)

The list of TRVs and CBRs that are developed for the HRSA will be provided to NJDEP in a memorandum for review and approval prior to conducting the BERA.

3.2.3.5 Risk Characterization

In the risk characterization step of the BERA, exposure and effects data are integrated into a statement about risk for each assessment endpoint established in the Problem Formulation (as provided in the SLERA). A weight-of-evidence approach will be used to interpret the implications of different studies or tests for each assessment endpoint. The risk characterization will include a detailed qualitative and a quantitative presentation of the risk results and uncertainties.

Quantitatively, EPCs will be compared to toxicity screening or reference values to derive hazard quotients or hazard indices for contaminants with the same mechanism of toxicity. Risks will then be characterized as low, medium, or high, depending on the magnitude of the hazard quotient. In addition, comparisons of risk estimates in the HRSA will be made with risk estimates from the regional background/reference areas to determine the incremental site risk associated with the Group facilities verses other sources.

Qualitatively, risk estimates will be placed in context with a description of their extent, magnitude, and potential ecological significance in the HRSA. In addition, a description of the various inherent uncertainties of the risk assessment process will be provided, as well as a perspective on their potential effects on the risk assessment conclusions. The results of the BERA will be used by NJDEP and the Group to evaluate risk management needs and, specifically, the need for a feasibility study to evaluate potential risk-based remedies for the HRSA.

4. Field Sampling Plan

This Supplemental RI Sampling Program involves the collection and analysis of sediment and tissue samples from the HRSA, and is based on a deterministic sampling design primarily associated with judgmental techniques. Judgmental sampling is the biased selection of sampling locations based on historical information, visual inspection, and professional judgment. The associated sampling depths and segmentation schemes were developed based on information gathered from the Reconnaissance and RI Programs, and are meant to meet the stated DQOs.

Specific details regarding the sample collection process as they relate to each DQO are identified below. Tables 4-1 through 4-3 provide a summary of the estimated number of samples, including QA/QC samples. Coordinates for each anticipated sampling location are provided in Tables 4-4 through 4-6 and are illustrated in Figures 4-1 and 4-2. The field SOPs for this SRIWP are provided in Appendix A as follows:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Decontamination
- SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 4 – Positioning
- SOP No. 5 – Habitat Characterization
- SOP No. 6 – Sediment Collection Using Hand Coring Device
- SOP No. 7 – Sediment Collection Using Vibracoring Device
- SOP No. 8 – Core Processing
- SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests
- SOP No. 10 – Benthic Invertebrate Community Sampling
- SOP No. 11 – Fish Tissue Sampling

- SOP No. 12 – Crab Tissue Sampling
- SOP No. 13 – Management and Disposal of Residuals
- SOP No. 14 – Tide Gage Installation

4.1 Supplemental Nature and Extent Sampling

To supplement the nature and extent evaluation of chemical constituents along the HRSA, cores will be collected from nine transects within the HRSA. Specifically, one core will be advanced to approximately 4 ft below sediment surface (bss) near the western shoreline along Transects 6, 8, 10, 12, 14, 16, 18, and 20, and between Transects 23 and 24. The 4-ft cores will be split into three segments for chemical analysis (0 to 0.5, 0.5 to 2, and 2 to 4 ft) for a total of 27 sediment samples. One additional core will be advanced to approximately 20 ft bss along Transect 5 near Core 005 to further assess sediment quality at this location. Four segments will be collected from this core (12 to 14, 14 to 16, 16 to 18, and 18 to 20 ft) for chemical analysis. Target analytes will be consistent with those evaluated in the RI, with the exception of AVS/SEM and radiochemistry, which will not be evaluated from core samples (Table 4-1).

Surface sediment samples will be collected as part of the BERA from grab samples along the five previously unsampled, remaining mudflats identified in the HRSA (Mudflats 3, 5, 7, 10, and 12). Note that although Mudflat 8 was not previously sampled, this mudflat has already been remediated as part of the IRMs for the Seaboard Site (Section 1.3). Analytical parameters in the surface sediment will be the same as those for the cores in addition to AVS/SEM analysis. Sample collection is detailed in Section 4.3.2.

To evaluate the extent of oil-like substances in HRSA sediments, sediment cores will be collected in a grid-like pattern near RI Cores 011 and 012 (Transect 11) and 013 (Transect 13; Figure 4-2). Initial cores will be advanced to a depth of approximately 4 ft bss and will be adjusted based on field observations to vertically delineate oil-like substance. Cores will be visually inspected for the presence of oil-like substances and screened with a photoionization detector (PID). Sampling will start at the locations where oil-like substance was previously observed (RI Cores 011, 012, and 013). Delineation cores will be collected outward in approximate 100 ft increments in a grid pattern until oil-like substances are no longer observed. When oil-like substances are no longer observed, additional cores will be collected 50 ft from the last core where oil-

like substances were observed to complete the horizontal delineation. Proposed delineation core locations depicted on Figure 4-2 will be adjusted (increased or decreased) based on field observations.

Oil-like delineation sediment cores may be segmented for laboratory analyses. Segmentation intervals will be completed consistent with procedures followed in this SRIWP and the previous RI Program. Select samples will be analyzed for PAHs, TEPH, TOC, and grain size (Table 4-1). Sediment sample selection will be based on field screening observations.

Sediment cores will be collected and processed following SOP Nos. 6, 7, and 8 and procedures summarized in Sections 4.1.1 and 4.1.2. In the event that cores are to be collected from the same sampling location as grab samples, the cores will be collected prior to collecting the grab samples and the first interval of the core will not be analyzed (i.e., the grab sample will be used to characterize surface sediment chemistry in this area).

4.1.1 Sediment Core Collection

To collect sediment cores for the nature and extent sampling, hand coring or vibracoring techniques will be used. Hand coring devices may be used to collect surface and subsurface sediment samples in relatively shallow waters. Details of the hand-coring procedures are presented in SOP No. 6 – Sediment Collection Using Hand Coring Device.

Vibracoring is the process of obtaining a continuous, well-preserved core from water-saturated, unconsolidated sediment. Vibracoring will be conducted from a vessel designed for deployment of the vibracorer and for the installation of the vibracorer and ancillary equipment. Prior to commencement of coring activities, the vessel will be positioned in accordance with SOP No. 4 – Positioning. Details of the vibracoring procedure are presented in SOP No. 7 – Sediment Collection Using Vibracoring Device.

Field conditions and professional judgment will be used to determine which method is appropriate for a given location; however, vibracoring will be preferred. The bathymetric survey and sediment data obtained during the Reconnaissance and RI Programs will be useful for this purpose as well.

Sediments will be retained in a polybutyrate core tube of nominal 4 inches outer diameter. The appropriate sample volume will be obtained from a single core ("primary core"), advanced to the target penetration (Table 4-4) or refusal if the target penetration cannot be reached. For a given core, the field crew will attempt to obtain the targeted penetration and recovery no more than three times. In cases where all three attempts are unsuccessful, the Lead Consultant PM will be contacted and professional judgment and field conditions will be used to determine if additional cores should be attempted.

4.1.2 Sediment Core Processing

Following collection activities, the cores will be brought to the on-shore Sample Processing Area for logging, photographing, and sample preparation. Core processing procedures are presented in SOP No. 8 – Core Processing, and will be followed during sample collection. Sampling equipment used during sample processing and collection will be decontaminated in accordance with SOP No. 2 – Decontamination.

Once the sample intervals have been identified, the sediments within the core will be observed and logged as described in SOP No. 8 – Core Processing. The exact processing procedures are dependent upon whether the core contains high water content sediments. Samples for chemical analyses will be collected from the pre-determined intervals presented in Section 4.1. Samples for VOCs will be taken directly from the core using the EnCore® sampling system, or similar VOC preservation sampling method. Samples for other analyses will be homogenized in a decontaminated stainless steel bowl prior to placing into sample jars for shipment to laboratories.

SOP No. 8 – Core Processing also presents the sample segments if a penetration depth less than the target depth is achieved. Additionally, if limited sample volume is recovered, the chemical analysis hierarchal prioritization provided in Table 4-7 will be followed. Table 4-7 also presents the desired minimum sample weights for each analysis.

4.2 Regional Background/Reference Area Sampling

Two cores will be collected from sampling locations upstream of the HRSA to represent regional background conditions. Three sediment depth intervals will be collected from each core for a total of six sediment samples for chemistry analysis. Core samples will be collected and processed as described in Section 4.1 above.

Composite surface sediment grab samples will be collected from two upstream reference area mudflat locations and one subtidal location, for a total of three composite surface sediment grab samples for chemistry analysis. The same two mudflat sediment locations will also be sampled for composite mummichog and crab tissue samples. In addition, three surface sediment samples will be collected for use as reference sediment for toxicity testing and three samples from each of three locations (total of nine samples) will be collected for benthic community analysis (Table 4-2). These will be collected as described in Section 4.3.

The sampling locations selected for background/reference area sampling will be determined in the field and will be outside of the site's potential influence and away from other direct sources of potential contamination, such as hazardous waste sites, sewer/storm water outfalls, etc. The Group will seek NJDEP approval of the target background/reference sampling locations pending their selection. The samples collected from these areas will be analyzed for the same chemical parameters as the HRSA samples. Sediment sample collection and processing will follow the same procedures and SOPs as described in Section 4.1. The sediment toxicity samples collected from the reference area will be used as a negative control for the samples collected from the HRSA. The surface sediment, mummichog, and crab tissue samples that are collected from the background/reference area will be used as regional background samples.

4.3 Baseline Ecological Risk Assessment

The following section describes the detailed collection of data required to complete the BERA.

4.3.1 Shoreline Habitat Characterization

The shoreline habitat characterization will occur following procedures outlined in SOP No. 5 – Habitat Characterization. The objectives of the shoreline habitat characterization assessment activities include the following:

- Understand the ecosystem that is potentially at risk within the HRSA as well as the physical and chemical stressors that may be affecting components of the ecosystem

- Identify environmentally sensitive habitats and natural resources that may occur in the HRSA and surrounding environs

- Identify potential contaminant migration pathways to any environmentally sensitive habitats

Shoreline observations will be made from a boat while navigating along the HRSA. Two shoreline events will be performed—one at high tide and one at low tide—to evaluate shoreline features during different tidal stages. Types of shoreline stabilization, adjacent land use, and vegetation above the high tide line will be characterized from the shoreline to beyond 100 ft of the river's edge during the high tide event. Mudflat locations and length, intertidal vegetation, depositional characteristics, and outfalls/discharge points will be documented during the low tide event. Habitat maps will be developed for the HRSA and will identify tributaries of the Hackensack River. In addition, detailed vegetative cover-type maps for all the environmentally sensitive areas of the PRG facilities will be provided.

If a habitat depth beyond 100 ft from the River's edge cannot be determined from boat surveys, a desktop literature review will be performed using a combination of topographical maps and aerial photos.

4.3.2 Surface Sediment Sampling and Processing

Surface sediment grab samples will be collected in the HRSA from designated locations along five mudflats as well as from four subtidal sampling locations. Figure 4-1 presents surface sediment grab sampling locations. One large mudflat (Mudflat 10) will have two sampling locations; the four smaller mudflats will have one sampling location each, for a total of 10 surficial grab sampling locations, One composite sediment sample will be collected from each location for chemical analysis and one for sediment toxicity testing. In addition, three replicate benthic community grab samples will be collected from each location (Tables 4-2 and 4-5).

The surface sediment grab samples will target the Biologically Active Zone (BAZ; i.e., top 6 inches of sediment) only, as this depth represents the material to which the ecological community is exposed. Surface sediment grab samples will be analyzed for the same chemical parameters as those analyzed for in the RI, in addition to AVS/SEM, and will be collected and processed according to SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests.

More than one grab sample will likely be required at each mudflat location to obtain the quantity/volume of sediment necessary to carry out all the analyses (i.e., chemistry,

toxicity testing, benthic community analysis). The field crew will attempt to remain within a 10 ft radius to gather the necessary surface sediments.

Samples collected for AVS/SEM and VOC analyses will each be collected from the first grab sample prior to homogenization or mixing. Sediment for AVS/SEM analysis will be collected from the center of the grab, placed into containers with no headspace, and capped as quickly as possible to minimize exposure to air. Sediment samples for VOCs will be collected from the same initial grab and prior to homogenization using the EnCore® Sampling System or similar device and placed in a sample collection jar. Samples for other chemistry analyses and toxicity testing will be homogenized in a decontaminated stainless steel bowl prior to placing into sample jars for shipment.

Once the sufficient number of grab samples has been collected for the chemistry and toxicity samples, three discrete samples will be collected for the benthic community analyses as described in SOP No. 10 - Benthic Invertebrate Community Sampling (i.e., the benthic community samples will be the last three grab samples collected; Table 4-2).

4.3.3 Benthic Invertebrate Community Sampling and Processing

Benthic invertebrates are the primary consumer level of the food web in the HRSA. These organisms comprise a substantial fraction of the diets of higher organisms in the HRSA including mummichogs and other forage fish, blue crabs, and juveniles of various predatory fish. Because of their close association with the sediments, benthic invertebrates accumulate and are directly affected by sediment-associated chemicals and, therefore, represent a substantial exposure pathway for higher organisms to bioaccumulative chemicals. For these reasons, it is important to evaluate the richness and abundance of the benthic community, as well as the potential effects of sediment-associated chemicals in the HRSA on these organisms. The latter is addressed in Section 4.3.2 above. The former will be evaluated as described below.

Sediment samples for benthic invertebrate community analysis will be collected from 10 HRSA sediment sampling stations (one large mudflat, four small mudflats, and four subtidal areas), as well as from three reference area locations (Tables 4-2 and 4-3). Three surface sediment samples will be collected from each station for benthic community analysis after samples have been collected for chemistry and toxicity analysis. The procedures for collecting bulk sediment samples to identify, sort, and count benthic invertebrates are described in detail in SOP No. 10 – Benthic Invertebrate Community Sampling.

The results of the benthic invertebrate surveys will be quantitatively evaluated in the laboratory for species richness (total number of taxa), abundance (total number of organisms), and dominance. Because the 10 HRSA sampling stations are located in areas with varying chemical mixtures, these metrics will be calculated for each station. The values calculated for each sampling station will be compared to each other, as well as to those from the reference area, and similar values calculated from historical data collected in the NY/NJ Harbor Estuary. In addition to species richness and abundance, the feeding guilds of the benthic community, and the relative abundance of pollution tolerant species will be quantified for each station and for the entire HRSA as well as the reference area. These data will be used to evaluate the HRSA with respect to habitat quality for benthic invertebrate populations.

4.3.4 Biological Tissue Sampling

The components of the biological tissue sampling program, including the target numbers of samples, analyses, and sampling locations are discussed below and presented in Tables 4-3 and 4-6. Three types of whole body organisms will be targeted for collection and analysis: mummichog (*Fundulus heteroclitus*), blue crab (*Callinectes sapidus*), and various species of upper-trophic level/predatory fish.

Biological tissue samples will be collected in accordance with SOP No. 11 – Fish Tissue Sampling and SOP No. 12 – Crab Tissue Sampling. The necessary scientific collecting permit(s) will be obtained from the State of New Jersey during the mobilization period for collecting aquatic organisms. If one or more of the collecting procedures described in this SRIWP are prohibited by the scientific collecting permit(s), then the SRIWP may be modified. No state or federal rare, threatened, or endangered species will be collected from the HRSA or reference area.

4.3.4.1 Fish Tissue

Fish tissue samples will be collected in accordance with SOP No. 11– Fish Tissue Sampling. As described in the SOP, sampling methods for fish will include monofilament experimental gill nets and baited minnow, Gee, or eel traps. Fish that are captured will be identified, weighed, measured (total length), sexed, and examined for any appreciable signs of abnormal morphological features or superficial lesions. Fish that are captured but not collected for the tissue-residue analyses will be released.

One composite mummichog sample will be collected using baited minnow traps from each of the six mudflat sediment sampling locations in the HRSA, along with one

duplicate sample. Mummichog tissue samples will be composited to obtain a sample mass of 20 to 50 grams. Individual organisms used in composite samples will be all the same species and sample composites will be segregated based on age and sex. If enough organisms cannot be collected to meet the specifications for compositing, then compositing may need to occur across sexes and sizes.

Upper-trophic level/predatory fish will be collected using gill nets and baited eel or Gee traps following SOP No. 11– Fish Tissue Sampling. Four fish species will be targeted for collection and analysis: Atlantic menhaden (*Brevoortia tyrannus*), striped bass (*Morone saxatilis*), white perch (*Morone americana),* and American eel *(Anguilla rostrata)*. Other species may be substituted as appropriate, based on the numbers of species captured.

Eight fish tissue samples will be collected from each of two HRSA sampling transects plus one duplicate sample for a total of 17 upper-trophic level predatory fish tissue samples. An attempt will be made to collect fish of comparable sizes and to collect fish from the defined stations, but this may not be practicable in all cases and compositing over a larger area and/or size class may be required.

4.3.4.2 Blue Crabs

Blue crabs will be collected using baited crab pots, and prepared for analysis as described in SOP No. 12 – Crab Tissue Sampling. One composite whole body blue crab sample consisting of 20 to 50 grams of soft tissue will be collected from each of the six HRSA mudflat sampling stations, plus one duplicate sample (Table 4-3). A larger sampling area will be used if sufficient crabs cannot be collected within the boundaries of the HRSA stations. Male blue crabs of similar size are to be preferentially used for compositing.

4.4 Implementation Procedures

This section presents the procedures required to implement the sampling program, including mobilization tasks, decontamination of equipment, vessel positioning, and associated field QC procedures.

4.4.1 Pre-mobilization

Subsequent to NJDEP approval of this SRIWP, pre-mobilization activities will commence and include the following:

- Obtaining the necessary permits
- Subcontractor selection and contracting
- Equipment specification and procurement
- Utility identification and clearing
- Staffing/general planning

The tasks of obtaining permits and identifying/clearing utilities are important and will be initiated as early as possible in the process. In conjunction with this, the U.S. Coast Guard Captain of the Port will be contacted to coordinate the overall sampling operations and to identify notification requirements for the Vessel Traffic Service or other public agencies.

4.4.2 Mobilization/Demobilization

Mobilization tasks will include the transportation of personnel, supplies, equipment, and subcontractors to the site, which will be undertaken prior to commencement of the field activities specified previously in this section. Other important activities to be conducted during mobilization are described below.

Health and Safety

Health and safety requirements applicable to the persons entering the secured location or involved in the SRIWP are described in the HASP (Appendix D). Among other things, the HASP describes personnel medical requirements, exposure limits, personnel protection requirements, and work areas.

Equipment Purchase/Site Set-Up

During mobilization procedures, pertinent equipment will be obtained and brought to the site, such as glassware, bowls, core liners, and other tools necessary for the project. A Sample Processing Area will be set up and arranged accordingly to ensure efficient and safe working conditions. Arrangements will also be made to ensure that the collected sediments and tissue samples are stored in a properly cooled environment prior to processing. Finally, proper documentation and equipment decontamination areas will be secured for this project to avoid cross-contamination.

Tide Gage Installation

Prior to the actual collection of sediment samples, a tide gage will be installed with the HRSA so that water levels can be measured and used for data reduction and interpretation. Tide gages will be installed according to SOP No. 14 – Tide Gage Installation.

4.4.3 Decontamination of Field Sampling Equipment

Decontamination is the process of neutralization, washing, and rinsing exposed surfaces of equipment to minimize or eliminate the potential for chemical migration and/or cross-contamination. Chemicals can be brought to a sampling location and/or introduced into the sampling media by equipment previously used at other sites or locations. Trace quantities of these materials can lead to false positive analytical results and, ultimately, to an incorrect assessment of the site conditions. Decontamination of sampling equipment (e.g., core tubes, water bottles, and other sampling equipment) and field support equipment (e.g., coring barge) is required to minimize or eliminate cross-contamination.

Equipment coming into contact with water, sediment, or tissue from the Hackensack River during the course of the field activities will require decontamination. Three levels of decontamination (e.g., solvent, soap and water, or river water decontamination) will be performed based on the usage of the sampling equipment. Sampling equipment that will come into contact with sediments will be decontaminated using the procedure approved by NJDEP (NJDEP 2005) prior to sampling. Decontamination methods for other equipment that will not come into contact with sediment for chemical analysis include either a wash with low-phosphate detergent (e.g., Alconox) and tap water or a wash with Hackensack River water. Descriptions of the three classifications and procedures are presented in SOP No. 2 – Decontamination.

In addition to the classifications described above, new equipment will also be decontaminated before use to remove potential fabrication residuals/chemicals (SOP No. 2 – Decontamination).

4.4.4 Positioning

A Digital Global Positioning System (DGPS) unit will be used to determine the position of each sampling location. Horizontal data will be presented in New Jersey State Plane coordinates (North American Datum 83). Coordinates for each planned sampling

location are presented in Tables 4-4 through 4-6 and illustrated on Figures 4-1 and 4-2. Vessel and sampler positioning will be conducted in accordance with SOP No. 4 – Positioning.

After determining that the vessel is positioned directly over the intended sampling location, sediment and tissue collection will be performed in accordance with the procedures specified in the SOPs, depending upon conditions in the field.

4.4.5 Sample Containers

To ensure that appropriate sample quantities are collected in certified, pre-cleaned containers, sample containers for this project will be supplied from commercial suppliers or laboratories. The containers for the chemical analysis of sediment samples will be cleaned to the quality control standards defined in the USEPA Office of Solid Waste and Emergency Response Directive #9240.0-05A, Specifications and Guidance for Contaminant-Free Sample Containers, December 1992. Biological tissue samples (i.e., fish and crab) for chemical analysis will be wrapped in aluminum foil and sealed in plastic bags. Container types, which will be provided for sample matrices anticipated to be collected, are provided in Table 4-8.

Sediment toxicity sample containers will have secure lids and be of sufficient size or number to hold 10 liters of sediment from each sampling location. Sample containers should be made of chemically inert materials to prevent contamination, which might result in artificial changes in toxicity.

4.5 Field QC Sample Collection

QC samples will be collected to determine the accuracy, precision, representativeness, comparability, and completeness of both field and laboratory procedures. Rinsate blanks and field duplicate samples will be collected and analyzed for chemical analyses; trip blank samples will be collected and analyzed for VOCs. Section 7.1 of this SRIWP provides detailed descriptions of the type and frequency of field QC samples to be collected.

Specific procedures to be used in the decontamination of field equipment are provided in SOP No. 2 – Decontamination. After the equipment is decontaminated and prior to re-use, a rinsate blank will be collected as described in Section 7.1.1. Table 4-9 presents sample collection and handling requirements for rinsate blanks collected for chemical analyses.

4.6 Field Documentation

Information collected in the field through visual observation or measurement will be recorded in a logbook and on prepared forms. Such information will be periodically reviewed by the Lead Consultant PM and/or their designees. Details of the field documentation requirements and pre-prepared forms are presented in SOP No. 1 – Field Documentation.

4.7 Sample Preservation and Holding Times

Procedures for sample preservation are outlined in SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. Appropriate preservatives, as necessary, will be added to the sample bottles in the field prior to sealing the bottle, packing, and shipping to the analytical laboratories. Documentation of the preparation and addition of these reagents will be supplied by the laboratory along with the sample containers.

4.7.1 Sediment Samples

Sediment samples for chemical analysis will be stored on ice after collection and will be chilled to 4 degrees Celsius (°C), pending processing, and will be shipped on wet ice to the appropriate analytical laboratories. Holding times for sediment samples are provided in Table 4-8.

Sediment samples for toxicity testing will be chilled to 4°C when collected, shipped on wet ice, and stored in the dark at 4°C until used. Sediments will be stored for no longer than two weeks before the initiation of the test, and will not be frozen or allowed to dry. As stated in the American Society for Texting and Materials (ASTM; 2004), field collected sediments should not be wet-sieved, but obvious large organisms and debris should be removed by forceps. Field collected sediment for toxicity will be processed in accordance with ASTM procedures.

Sediment samples for benthic community analysis will be preserved and shipped as described in SOP No. 10 – Benthic Invertebrate Community Sampling.

4.7.2 Biological Tissue Samples

Fish that are collected for tissue analysis will be placed directly on wet ice at the time of collection. For the fish that will be analyzed as a composite sample (e.g.,

mummichogs), specimens will be bagged and placed directly on wet ice at the time of collection. Specimens that are retained for analysis (as individuals or composites) will be brought to the sample processing area where they will be wrapped whole in aluminum foil (shiny side out), placed in sealed (and labeled) plastic bags, and stored in a freezer prior to shipment on ice.

Crabs that are collected for tissue analysis will be placed directly on wet ice at the time of collection and brought to the sample processing area. Crabs will be processed at the sample handing trailer in accordance with SOP No. 12 – Crab Tissue Sampling. Crab tissue samples will be wrapped in freezer paper, placed in sealed (and labeled) plastic bags, and stored in a freezer prior to shipment on ice.

4.8 Sample Handling and Custody Requirements

This section describes procedures for sample identification, chains-of-custody, and field documentation for collected samples. The purpose of these procedures is to maintain the quality of samples during collection, transportation, and storage prior to laboratory analysis. This section presents custody procedures to be followed prior to, during, and after sample collection by field and laboratory personnel.

4.8.1 Sample Handling and Shipment

The handling of samples from the time of collection through transportation to the laboratory will be conducted in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. A summary of the procedures provided in this SOP is presented below.

A label will be attached to each bottle or bag used for shipping samples. When practical, the company-specific project number (if appropriate), sample matrix, laboratory designation, and sample identification code will be typed or printed onto the label before sampling. An example pre-printed label is included in SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

Sample containers will be properly labeled and the sample containers will be closed and secured with tape (if the containers have lids) prior to packaging and shipment. Samples ready for packaging will be placed in individual sealable plastic bags. Samples shipped in sealable plastic bags will be double bagged. An appropriate number of bagged samples will be placed in a shipping container (e.g., cooler with lid), leaving adequate space for packing material and ice. Packing material will be made of

an inert substance and will be capable of eliminating or limiting damage to the sampling containers during transit to the laboratory. Ice or an ice substitute will be secured in sealable plastic bags to prevent leaking of condensation or melt water, and placed around the samples in the shipping container. A temperature blank provided by the analytical laboratory with each shipping container will be included. Sediment samples will maintain a temperature of 4°C during shipment; biological tissue samples will be shipped frozen on ice. The completed chain-of-custody and other necessary paperwork will be sealed in a plastic bag and then secured to the inside of the shipping container lid.

Once packed, the shipping container lid will be closed and secured with a signed and dated custody seal. The custody seal will be placed in such a manner as to show whether or not the lid was opened or tampered with during transit to the laboratory. After applying the custody seal, the container lid will be taped shut. If a laboratory courier is being used, the container is ready for shipment. However, if a commercial shipping company is used, the air bill or packing/shipping paperwork should be affixed to the top of the container and relevant tracking information should be recorded on the chain-of-custody form prior to sealing the shipping container.

4.8.2 Chain-of-Custody Procedures

Handling of samples from the time of collection through transportation of samples for laboratory analysis will follow chain-of-custody procedures. Field personnel will maintain the collected samples following proper custody procedures until they are picked up by the laboratory courier or a shipping container is sealed with a custody seal and received by a representative of a shipping company. In circumstances where a shipping company is used, the air bill or shipping/packing slip will act as documentation of custody.

In general, a sample is under the sampler’s custody if one or more of the following criteria are met:

- The sample is in the sampler's possession
- The sample is in the sampler's view after being in possession
- The sample was in the sampler's possession and then locked up to prevent tampering

- The sample is in a designated secure area

Detailed chain-of-custody procedures to be used during core collection and sample processing activities are provided in SOP No. 3 – Container, Preservation, Handling, and Tracking of Samples for Analysis.

4.8.3 Laboratory Sample Receipt

Upon receipt at the laboratory, laboratory personnel will inspect the samples for integrity, check the shipment against the chain of custody, and document discrepancies on the chain-of-custody form. Each shipping container's custody seal will be checked for evidence of tampering. If evidence of tampering is found, laboratory personnel will note it on the chain-of-custody and contact the Lead Consultant PM or Quality Assurance Coordinator (QAC). If the custody seal is intact, laboratory personnel will measure the temperature within each shipping container and record the measurement on the chain-of-custody. If the shipping container's temperature exceeds the target temperature of 4°C, the laboratory will contact the Lead Consultant PM or QAC to determine further action.

The integrity of the individual sample containers will also be checked. If laboratory personnel identify a broken sample container, it will be noted on the chain of custody and the Lead Consultant PM or QAC will be contacted. If the custody seal is intact, the temperature is within the acceptable range and the sample containers are intact, the laboratory will proceed with the analysis procedures requested.

Once the field chain-of-custody has been verified complete, the samples will be logged into the laboratory's computerized tracking system, which assigns a unique lab ID number to each sample. The analyses required are specified by codes assigned to the sample at log-in. Labels containing the laboratory sample number are generated and placed on the sample bottles or sealable bags.

After the samples are labeled, they will be moved to locked refrigerators where they will be maintained at a target temperature of 4°C. Samples to be analyzed for volatile organics will be stored separately to minimize the risk of cross-contamination. Access to the refrigerators will be limited to members of the sample management department.

Laboratory personnel are responsible for the care and custody of samples from the time they are received, either by a laboratory courier at the site or via shipment directly

to the laboratory facility, until the samples are returned to the client for ultimate disposal.

4.8.4 Internal Laboratory Chain-of-Custody Procedures

The field chain-of-custody is complete when the samples are received at the laboratory. Laboratory personnel will begin and maintain an internal chain of custody once the samples have been received. This laboratory-specific chain-of-custody will document the handling and processing of samples from receipt at the laboratory through final disposal.

When samples are required for analysis, the analyst will fill out a sample request form and give it to the Sample Custodian, who will locate the samples, sign and date the internal chain of custody, and relinquish custody to the analyst. The analyst in turn will sign and date the chain-of-custody to accept custody of the sample. When the analyst is finished with the sample, the unused portion will be returned to the Sample Custodian. Both the analyst and Sample Custodian will sign and date the chain of custody. The sample will then be returned to secure storage. In the event that the entire sample is depleted during analysis, a notation of “sample depleted” or “entire sample used” will be made on the chain-of-custody.

Sample extracts and digestates will be maintained by the laboratory on their own chain- of-custody. Sample extract custody will begin with an extraction, digestion, or distillation log, as appropriate to the analysis. Upon completion of the preparation, an extract chain-of-custody form will be initiated. The extracts will then be given to the analyst with the time and date noted on the form. The analyst will place the extracts in designated secure storage areas. Transfers of the extract into and out of the storage area will be noted on the chain-of-custody form. Samples and sample extracts will be maintained in secure storage. Samples will be held for a minimum of 90 days and extracts for 365 days after data submission.

Upon completion of the requested analyses, laboratory documentation including, but not limited to, sample results, field and internal chains-of-custody, instrument calibrations, extraction and dilution information, and instrument run logs will be provided to the data validator as part of the final data deliverable package upon completion of the sample analysis and appropriate lab QA/QC. This documentation will meet the requirements further detailed in Section 8. Data validation will be completed to assess laboratory compliance with the procedures described in this SRIWP, completeness of the analytical data package, and fulfillment of project requirements.

Additional information pertaining to data validation is presented in Section 8 of this SRIWP.

4.9 Management and Disposal of Investigation-Derived Waste

Investigation-derived waste generated during sampling and processing will be handled and disposed of according to SOP No. 13 – Management and Disposal of Residuals.

5. Project Management/Task Organization

The organizational and project management structure of the HRSA Supplemental RI Project Team (herein referred to as the Project Team) is presented in this section. In accordance with N.J.A.C. 7:26E (N.J.A.C. 2002), the team members identified include major contractors (and subcontractors) who will implement this SRIWP. This section also serves to identify key individuals expected to participate in the work, and describes each person's respective responsibilities.

Figure 5-1 provides a Project Organization chart that illustrates the organizational structure associated with this SRIWP, and the relationships that exist among the various parties. While the Group expects that the overall project organization structure and associated Project Team will remain consistent throughout the program, it is possible that changes could occur. In such cases, NJDEP will be advised of such changes according to N.J.A.C. 7:26E (N.J.A.C. 2002).

5.1 Project Management

The overall Project Management Team will consist of NJDEP personnel and representatives from the Group. Each personnel group is briefly described below.

5.1.1 NJDEP

The NJDEP will serve as the Lead Agency on this project, and Mr. Christopher Kanakis will serve as the Site Manager (SM). The SM will monitor the overall progress of the work and communicate, as necessary, with the Group representative.

5.1.2 Peninsula Restoration Group

For the Group, Mr. Mitchell Brourman (Beazer) will serve as the Facility Coordinator (FC). The FC will be responsible for implementing the Supplemental RI Program. This individual will also have the authority to commit the resources necessary to meet the project objectives and requirements. The FC's primary function is to ensure that technical, financial, and scheduling objectives are achieved successfully. In addition, the FC will serve as the primary point of contact and control for matters concerning the project.

5.2 SRIWP Implementation Team

This section describes the organizations and individuals responsible for designing and implementing the program associated with this SRIWP.

5.2.1 ARCADIS

ARCADIS, U.S., Inc. will serve as the Group's Lead Consultant for the Supplemental RI Program. In this role, ARCADIS will assist the Group in the overall planning and coordination of the work efforts. Mr. Robert Romagnoli will serve as Project Manager (PM) and Mr. Alain Hebert will serve as the Assistant Project Manager for ARCADIS.

The ARCADIS PM will be responsible for providing overall technical support on the project and will serve as a key contact to the Project Management Team. This individual will also be responsible for directing ARCADIS work efforts and reviewing work products, including memoranda, letters, and reports transmitted from ARCADIS. In addition to this lead role, it is anticipated that ARCADIS will be responsible for the collection of the surface sediment and tissue samples, as well as for the receipt of collected cores, and processing the samples in accordance with the SRIWP.

5.2.2 Environmental Standards, Inc.

The Group anticipates that Environmental Standards, Inc. (ESI) will provide data management services for this Supplemental RI Program, including QA oversight, coordination with the laboratories, and data validation activities. Mr. Dave Blye will serve as the QAC.

5.2.3 Ocean Surveys, Inc.

The Group anticipates that sediment core collection activities will be completed by Ocean Surveys, Inc., Old Saybrook, Connecticut, with Mr. George Reynolds acting as PM. Mr. Reynolds will provide the technical and administrative oversight necessary to guide this process.

5.2.4 Laboratories

As appropriate, New Jersey-certified laboratories will be used to conduct the chemical analyses on the sediment and tissue samples. A total of four laboratories are anticipated to be used:

- Vista Analytical, El Dorado Hills, California
- TestAmerica, Inc., Pittsburgh, Pennsylvania
- Springborn Smithers, Wareham, Massachusetts
- Normandeau Associates, Inc., Stowe, Pennsylvania

The specific analyses to be provided by these laboratories are identified in Section 6.3.

5.2.5 Special Training/Certification

Personnel engaged in sampling activities are required to have proper Health and Safety Training as required by the Occupational Safety and Health Administration (OSHA) Regulation 29 CFR 1910.120 (HAZWOPER). Personnel who completed their initial HAZWOPER training more than 12 months prior to the start of the project will have completed an 8-hour refresher course within the past 12 months. The Contractor's Site Supervisor will have completed an additional 8 hours of supervisory training and have a current first aid/cardiopulmonary resuscitation certificate. In addition, personnel who are potentially exposed to HRSA contaminants will participate in a medical surveillance program as defined by OSHA at 29 CFR 1910.120(f). Field personnel collecting samples and/or operating field instrumentation will be trained in the required field SOPs (Appendix A).

Certificates or documentation representing completion of specialized training shall be maintained by the Lead Consultant. Refer to the HASP (Appendix D) for additional information relative to this topic.

Laboratories performing analytical work in support of this project are required to have each analyst demonstrate an ability to generate an acceptable initial demonstration of capability, along with acceptable results according to method recommendations and stated project DQOs. They are also to be certified in New Jersey.

Documentation representing successful completion of individual analyst initial demonstration of capability as described above will be maintained by the laboratory's QA Manager or their designee.

6. Project Quality Objectives and Measurement Performance Criteria

6.1 Data Quality Indicators

Data quality indicators (DQIs) are developed to ensure that the data collected will be of sufficient quantity and quality to serve their intended uses. This section describes the DQIs pertaining to type, quantity, and quality of data.

6.1.1 Levels of Data Quality

DQIs are based on the concept that different data uses require different levels of data quality. Data quality can be defined as the degree of uncertainty in the data with respect to precision, accuracy, representativeness, completeness, and comparability. The four general levels of data quality are as follows:

Screening (Level 1): This provides the lowest data quality, but the most rapid results. It is used primarily for initial site characterization to locate areas for subsequent higher quality analysis, health and safety monitoring, and initial screening of alternatives (i.e., bench-scale tests). These include monitoring equipment data such as a PID and flame ionization detector, as well as pH, dissolved oxygen, conductivity, and temperature meters.

Field Analysis (Level 2): This provides rapid results and better quality than Level 1. Analyses include data generated in a mobile laboratory.

Engineering (Level 3): The data quality generated at this level is intermediate and is used for site characterization. These analyses may include mobile laboratory-generated data, some analytical laboratory methods (i.e., laboratory data used for screening that lack full QC documentation), and toxicity testing.

Confirmation (Level 4): This provides the highest level of data quality and is used for purposes of risk assessment, feasibility studies, remedial design, and cost analysis. Full Contract Laboratory Program (CLP)-type reporting is used for those analyses which, based on the intended data use, require full documentation.

Chemical analyses will be performed using procedures designed to produce Level 4 data quality. Grain size, moisture content, pH, and oxidation-reduction potential (ORP) analyses will be performed by an off-site laboratory with Level 3 reporting.

6.1.2 Analyte-Specific Data Quality Indicators

Analyte-specific DQIs or sample quantitation limits (SQLs) for parameters proposed for analysis during the SRIWP are provided in Tables 6-1 through 6-11. These reporting limits will be used as target analyte-specific DQOs.

6.2 Data Quality Measurement Parameters

All data are potentially subject to some uncertainty and error as they are generated through sampling, analysis, and reporting. Control and recognition of errors is important in assessing data quality and preparing technical reports. The impact of data uncertainty and errors on the project can be reduced in two ways: 1) through QC measures; and 2) through documentation of the quality or nature of data error or uncertainty of the data generated.

An assessment of the performance of five data quality measurement parameters: precision, accuracy, completeness, representativeness, and comparability are performed and discussed in this section. Quantitative limits for acceptable precision, accuracy, and completeness are discussed below.

6.2.1 Precision

Precision is the measure of variability between individual sample measurements of the same property under prescribed similar conditions. The measurement of precision is made through the use of replicate samples taken at regular, specified intervals.

Replicate samples are collected in the field, homogenized before being split into two distinct samples (also known as field duplicates) or prepared during laboratory analysis (laboratory duplicates), and are expected to contain identical contaminant concentrations. Therefore, any variability in the reported analyses is attributable to variability introduced by sampling, handling, matrix homogeneity, or analytical procedures. Analysis of field duplicate samples provides an estimate of overall sampling and analysis precision. Analysis of laboratory duplicates provides an estimate of analytical precision.

The frequency of collection of field duplicate samples is discussed in Section 7.1.2, and Tables 7-1 and 7-2. The precision of field replicate analyses (field duplicates) and laboratory replicate analyses is expressed as relative percent difference (RPD).

Field precision and inorganic analytical precision will be expressed as RPD for co-located and homogenized duplicate field sample results and laboratory duplicate analysis results, as described below:

$$RPD\,(\%) = \frac{|S - D|}{(S + D)/2} \, x\,100$$

Where:

S = first sample value (original)

D = second sample value (duplicate)

Organic analytical precision will be expressed as the RPD of the %Recovery (%R) for the matrix spike/matrix spike duplicate (MS/MSD) samples as follows:

$$RPD\,(\%) = \frac{|R1 - R2|}{(R1 + R2)/2} \, x\,100$$

Where:

R1 = MS

R2 = MSD

Laboratory acceptance limits for precision are stated in Section 6.3. The control limits for precision to be used in data validation are stated in Section 8.

6.2.2 Accuracy

Accuracy is a measure of the bias in a system and can be defined as the degree of agreement between a measurement and an accepted reference or true value. The

exact bias of a system is never known since the true values are not accessible. However, inferences can be drawn from an evaluation of various analyses. The accuracy or bias of a laboratory analysis is evaluated by analyzing standards of a known concentration both before and during sample analysis. Bias is also evaluated by spiking a sample (MS) with a known concentration of a chemical and measuring its actual, versus expected, recovery in analysis. Similarly, any bias introduced by laboratory contaminants is detected during blank analysis. Analytical quality control samples, which will be used to control analytical accuracy, are discussed in Section 7.2. Analytical accuracy is also measured through procedures detailed in the SOPs of most analytical methods.

Accuracy will be expressed as %R for spiked samples (surrogate spikes, LCS) as follows:

$$\%R = \frac{A}{B} x\, 100$$

Where:

A = measured concentration in spiked sample or standard

B = true value of concentration added to sample, or true value of standard

In addition, the MS/MSD sample results will be used to calculate the %R in accordance with the following formula:

$$\%R = \frac{(A - X)}{B} x\, 100$$

Where:

A = measured concentration in spiked sample or standard

X = original concentration in sample prior to spiking

B = true value of concentration added to sample, or true value of standard

Laboratory acceptance limits for accuracy are discussed in Section 6.3. The control limits for accuracy to be used in data validation are discussed in Section 8. Accuracy in regards to sampling procedures is also evaluated through the use of blanks. For example, equipment rinsate blanks may demonstrate bias introduced by contaminated sampling equipment, sample containers, or sample handling. Section 7.1 presents a discussion of QC samples collected in the field to be used to evaluate the accuracy of the data.

6.2.3 Representativeness

Representativeness is the degree to which a set of data may accurately represent the characteristics of a population, parameter conditions at a sample point, or an environmental condition. Representativeness is evaluated by collecting QC samples and performing sampling and sample handling/processing in compliance with appropriate procedures. Field SOPs, or detailed descriptions of sample collecting, handling, and processing procedures, are found in Appendix A.

6.2.4 Completeness

Field completeness is a measure of the number of samples planned to be collected compared to the number of samples that are received in acceptable condition by the laboratory(ies). Analytical completeness is a measure of the number of overall accepted analytical results (including estimated values) compared to the total number of analytical results requested on samples submitted for analysis. Both the overall field completeness and overall analytical completeness goals are 90 percent for the SRIWP.

Following validation of the data packages in accordance with the provisions of Section 8, assessment of the data with respect to fulfillment of QA objectives will be accomplished by the joint efforts of the Lead Consultant PM, QAC, and FC. This assessment will consider sample collection, sample handling, field data, blank values, field duplicate values, and additional data flags or qualifiers.

The overall field completeness will be calculated by the ratio of the number of samples received in acceptable condition by the laboratories to the number of samples planned to be collected as specified in this document. The equation for overall field completeness is:

$$\%\ Field\ Completeness = \frac{Number\ of\ Samples\ Received\ by\ Laboratories}{Total\ Number\ of\ Samples\ Planned\ to\ be\ Collected}\ x\ 100$$

The overall analytical completeness will be calculated by the ratio of total valid analytical data results (including estimated values) to the total number of analytical results requested on samples submitted for analysis. The equation for the overall analytical completeness is:

$$\%\ Analytical\ Completeness = \frac{Total\ Valid\ Analytical\ Data}{Analytical\ Data\ Obtained}\ x\ 100$$

Analytical and field completeness will be determined and compared to their respective goals as stated above. If the goals are not met, the Lead Consultant PM, QAC, and FC will decide if the data are sufficient for site characterization and other data uses. If it is judged that the data are inadequate, additional field samples may be collected and analyzed to accomplish the study goals. Decisions to repeat sample collection and analysis may be made by the FC in consultation with the Lead Consultant PM and QAC.

6.2.5 Comparability

Comparability expresses the confidence with which one set of data can be compared to another to measure the same property. Data can be compared to the degree that their accuracy, precision, and representativeness are known and documented. Data are comparable if QC measures such as collection techniques, measurement procedures, analytical methods, and reporting units are equivalent for the samples within a sample set. Data subject to established QA/QC measures are deemed more reliable and, therefore, more comparable, than data generated without such measures.

6.3 Analytical Methods

This section describes the analytical methods to be used during the implementation of the SRIWP. The QA/QC methodologies specified in this section are set forth in:

- USEPA SW-846 Test Methods for Evaluating Solid Waste, Third Edition, December 1996

- Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Invertebrates, ASTM E1367 – 03(2008)

Table 6-12 presents a summary of the SW-846 and other analytical methods selected for use as part of this SRIWP. The methods stated herein will be implemented by personnel experienced and trained in the use and application of the methods. If, because of matrix effects or other unforeseeable circumstances, the stated methods are unable to provide satisfactory results, other analytical methods may be utilized to successfully complete the analysis. Laboratories will provide written notification to the Lead Consultant PM and QAC describing modifications to the required method prior to analysis. Laboratories will receive written approval from the QAC of such modifications prior to analysis.

The extraction and analytical methods to be used are specified in Table 6-12. Copies of the laboratory SOPs for these methods are included as Appendix B of this SRIWP. The analyses will be performed as stated in the referenced SOPs. Laboratories retained to perform analyses of samples shall strictly follow these procedures. For each analytical method, the target analytes and quantitation or detection limit requirements are listed in Tables 6-1 through 6-11 of this SRIWP. The accompanying data verification and validation procedures are provided in Section 8.

6.3.1 Sediment and Rinsate Blanks

The following section discusses the methods that will be employed for sediment analyses. Aqueous methods are also discussed for analysis of rinsate blank samples.

6.3.1.1 SVOCs

Semivolatile organics for aqueous samples will be extracted by Method 3520C and solid samples will be extracted by Method 3541, with both matrices analyzed by Method 8270C, as specified in Table 6-12. The method employs gas chromatography/mass spectrometry (GC/MS) for determining the semivolatile organics in sample extracts. Copies of the laboratory SOPs for the analytical method and extraction method are included in Appendix B of this SRIWP. The specific target compound list (TCL) and SQL requirements are specified in Table 6-1.

The limits for MS/MSD accuracy and precision for semivolatile organics in aqueous and solid matrices are laboratory-specific and will be developed following the procedures outlined in Section 8.0 of the analytical method (Method 8000B). Likewise,

LCS and surrogate %R limits will be developed following the procedures outlined in Section 8.0 of Method 8000B. For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.1.2 Volatile Organics

Volatile organics for aqueous samples will be purged and trapped by Method 5030B and solid samples will be purged and trapped by Method 5035A, with both matrices analyzed by Method 8260B, as specified in Table 6-12. The method employs a GC/MS for determining the volatile organics in water and sediment sample matrices. A copy of the laboratory SOP for this method is included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Table 6-9.

The limits for MS/MSD accuracy and precision for volatile organics in aqueous and solid matrices are laboratory-specific and will be developed following the procedures outlined in the analytical method (Method 8000B) provided in Appendix B. Likewise, LCS and surrogate %R (recovery) limits will be developed following the procedures outlined in Section 8.0 of Method 8000B. For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.1.3 Pesticides

The extraction method for organochlorine pesticides in sediment will be Method 3541 and the extraction method for pesticides in water will be Method 3510C, as specified in Table 6-12. The analysis method (Method 8081A) employs GC utilizing an election capture detector. Copies of the laboratory SOPs for the analytical method and extraction method are included in Appendix B of this SRIWP. The specific TCL and SQL requirements are listed in Table 6-2.

Detected pesticides will undergo confirmatory analysis on a chemically dissimilar second column. Fully compliant analyses, including QA/QC check standards, will be processed for both primary and confirmatory analyses.

The limits for MS/MSD accuracy and precision for specific pesticide analytes in aqueous and solid matrices are laboratory-specific and will be developed following the procedures listed in Section 8.0 of Method 8000B (Appendix B). Likewise, surrogate %R limits will be developed following the procedures outlined in Section 8.0 of Method 8000B. For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.1.4 Chlorinated Herbicides

The extraction and analysis method for chlorinated herbicides for water and sediment will be Method 8151A, as specified in Table 6-12. This method employs a GC utilizing an electron capture detector. A copy of the laboratory SOP for this analytical method is included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Table 6-6.

Detected herbicides will undergo confirmatory analysis on a chemically dissimilar second column. Fully compliant analyses, including QA/QC check standards, will be processed for both primary and confirmatory analyses.

The limits for MS/MSD accuracy and precision for chlorinated herbicides for aqueous and sediment matrices is laboratory-specific and will be developed following the procedures outlined in Method 8000B. Limits for accuracy of surrogate recoveries are calculated by the laboratory from historical data, as specified in Method 8000B. The MS, MSD, LCS, and surrogate limits will be developed in accordance with the analytical method and the laboratory's in-house statistically derived limits will be used.

6.3.1.5 PCB Congeners and PCB Homologues

The extraction/analysis method for PCB congeners and homologues for water and sediment will be USEPA Method 1668A, as specified in Table 6-12. The method employs high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) and provides for positive detections at relatively low detection limits. A copy of the laboratory SOP for this method is included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Tables 6-4 and 6-5.

The MS, MSD, and internal standards limits will be developed in accordance with the analytical method and the laboratory's in-house statistically derived limits will be used. Also, the method required ongoing precision and recovery (OPR) standard will have observed final concentrations for each target analyte within the acceptance ranges listed in the analytical method (Appendix B).

6.3.1.6 Aroclor PCBs

The extraction method for multi-component PCBs for aqueous samples will be Method 3510C and the extraction method for PCBs in sediment samples will be Method 3541, as specified in Table 6-12. The analysis method (Method 8082) employs GC utilizing

an electron capture detector. Copies of the laboratory SOPs for the analytical and extraction methods are included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Table 6-3.

Detected PCBs will undergo confirmatory analysis on a chemically dissimilar second column. Fully compliant analyses, including QA/QC check standards, will be processed for both primary and confirmatory analyses. An MS for PCBs will be performed by spiking with Aroclor 1254. Details of the analytical procedure are presented in Appendix B of this SRIWP.

The limits for MS/MSD accuracy and precision for specific Aroclors in aqueous and solid matrices are laboratory-specific and will be developed following the procedures listed in Section 8.0 of Method 8000B (Appendix B). Likewise, surrogate %R limits will be developed following the procedures outlined in Method 8000B. For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.1.7 PCDDs/PCDFs

PCDDs/PCDFs will be analyzed by Method 1613, Revision B (1613B), October 2001, as specified in Table 6-12. A copy of the laboratory SOP for this analytical method is included in Appendix B of this SRIWP. This method uses HRGC/HRMS in the Selective Ion Monitoring (SIM) mode for the detection and quantitation of PCDDs (tetra through octachlorinated homologues) and PCDFs (tetra through octachlorinated homologues) at part per trillion (ppt) concentrations for sediment and picogram per liter (pg/L) concentrations for aqueous samples. USEPA Method 1613B is considered preferable to SW-846 Method 8290. Method 1613B incorporates additional labeled internal standards for 2,3,7,8-substituted isomers, except the octachlorinated dibenzofuran, providing more accurate and reliable results. The specific TCL and SQL requirements are specified in Table 6-7.

The limits for MS accuracy for PCDD/PCDF analyses in aqueous and sediment matrices will be developed in accordance with the analytical method and the laboratory's in-house statistically derived limits will be used. Labeled analog standards added to each sample prior to preparation for analysis will have calculated %R within the laboratory-specific acceptance range. Initial precision and recovery standards, OPR standards, and the calibration verification standards will fall will also be developed in accordance with the analytical method and the laboratory's in-house statistically derived limits will be used.

6.3.1.8 Total Extractable Petroleum Hydrocarbons

TEPH will be analyzed by the NJDEP Office of Quality Assurance Analytical Method NJ-TPH-QAM-025-02/08, as specified in Table 6-12, with the following specific requirements. The extraction solvent used will be methylene chloride. Aqueous samples will be extracted either with a separatory funnel or by a continuous liquid-liquid extraction. The analytical results reported will include those hydrocarbons within the C_8 to C_{40} range. Integration of the chromatographic peaks for these hydrocarbons will include peak areas above the baseline. Quantitative results will be based on a five-level calibration curve using the external standard technique. A representative TEPH standard, #2 diesel should be used to perform the instrument calibration. Two surrogate compounds (chlorobenzene and ortho-terphenyl) will be added to each sample. A copy of the laboratory SOP for this NJDEP method is included in Appendix B of this SRIWP. The specific SQL requirements are specified in Table 6-11.

For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.1.9 Hexavalent Chromium

Hexavalent chromium in aqueous and solid samples will be analyzed using Method 7199, and extracted using Method 3060A, as specified in Table 6-12. Copies of the laboratory SOPs are included in Appendix B. The specific SQL requirements are specified in Table 6-11.

6.3.1.10 TAL Metals and Cyanide

As specified in Table 6-12, the cold vapor atomic absorption (CVAA) technique (SW-846 7470A or 7471A as appropriate) will be used for mercury analyses. Inductively coupled plasma emission spectroscopy (SW-846 6010B) will be used to quantify the remaining metals. Colorimetric method 9012A will be used for cyanide. Copies of the laboratory SOPs for the preparation and analytical methods for TAL metals and cyanide are included in Appendix B of this SRIWP. The specific TAL and SQL requirements are specified in Table 6-8.

The limits for MS and LCS accuracy (%R) for TAL metals and cyanide in aqueous and solid matrices should be laboratory-specific and developed according to USEPA SW-846 procedures. Likewise, analytical duplicate precision (RPD) acceptance limits are laboratory-specific and are developed according to USEPA SW-846 procedures. For

the MS, and LCS limits, the laboratory's in-house statistically derived limits will be used.

6.3.1.11 AVS/SEM

Select metals (Ag, Cd, Cu, Pb, Hg, Ni, and Zn) from the top 6 inches of surface sediment grab samples will be analyzed using AVS/SEM Method EPA-821-R-91-100/6010B. Copies of the laboratory SOPs for the analytical method are included in Appendix B. The specific SQL requirements are specified in Table 6-10.

6.3.1.12 Physical Parameters

TOC, grain size, pH, ORP and percent moisture analyses for sediment samples will be performed using the methods specified in Table 6-12. Copies of the laboratory SOPs for these analyses are provided in Appendix B of this SRIWP. Both pH and ORP will be measured in the field during core processing and in the laboratory during sample analysis.

The limits for accuracy for the TOC analyses are 50 to 150 percent. The limits for precision, based on RPD between duplicate analyses, are 20 percent for aqueous samples and 35 percent for sediment samples. The specific SQL requirements for these other analyses/parameters are specified in Table 6-11.

6.3.2 Biological Tissue

The following section discusses the methods to analyze biological tissue (i.e., fish and blue crab) samples.

6.3.2.1 SVOCs

Semivolatile organics for tissue samples will be extracted by Method 3541, and analyzed by Method 8270C, as specified in Table 6-12. The method employs GC/MS for determining the semivolatile organics in sample extracts. Copies of the laboratory SOPs for the analytical method and extraction method are included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Table 6-1.

The limits for MS/MSD accuracy and precision for semivolatile organics in tissue are laboratory-specific and will be developed following the procedures outlined in Section 8.0 of the analytical method (Method 8000B). Likewise, LCS and surrogate %R limits

will be developed following the procedures outlined in Method 8000B. For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.2.2 Pesticides

The extraction method for organochlorine pesticides in tissue samples will be Method 3541, as specified in Table 6-12. The analysis method (Method 8081A) employs GC utilizing an election capture detector. Copies of the laboratory SOPs for the analytical method and extraction method are included in Appendix B of this SRIWP. The specific TCL and SQL requirements are listed in Table 6-2.

Detected pesticides will undergo confirmatory analysis on a chemically dissimilar second column. Fully compliant analyses, including QA/QC check standards, will be processed for both primary and confirmatory analyses.

The limits for MS/MSD accuracy and precision for specific pesticides in tissue samples are laboratory-specific and will be developed following the procedures listed in Section 8.0 of Method 8000B (Appendix B). Likewise, surrogate %R limits will be developed following the procedures outlined in Method 8000B. For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.2.3 Chlorinated Herbicides

The extraction and analysis method for chlorinated herbicides for tissue samples will be Method 8151A, as specified in Table 6-12. This method employs a GC utilizing an electron capture detector. A copy of the laboratory SOP for this analytical method is included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Table 6-6.

Detected herbicides will undergo confirmatory analysis on a chemically dissimilar second column. Fully compliant analyses, including QA/QC check standards, will be processed for both primary and confirmatory analyses.

The limits for MS/MSD accuracy and precision for chlorinated herbicides for tissue samples are laboratory-specific and will be developed following the procedures outlined in Method 8000B. Limits for accuracy of surrogate recoveries are calculated by the laboratory from historical data, as specified in Method 8000B. For the MS, MSD,

LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.2.4 PCB Congeners and PCB Homologues

The extraction/analysis method for PCB congeners and homologues in tissue samples will be USEPA Method 1668A, as specified in Table 6-12. The method employs HRGC/HRMS and provides positive detections at relatively low detection limits. A copy of the laboratory SOP for this method is included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Tables 6-4 and 6-5.

The MS, MSD, and internal standards limits will be developed in accordance with the analytical method and the laboratory's in-house statistically derived limits will be used. Also, the method required ongoing precision and recovery (OPR) standard will have observed final concentrations for each target analyte within the acceptance ranges listed in the analytical method (Appendix B).

6.3.2.5 Aroclor PCBs

The extraction method for Aroclor PCBs in tissue samples will be Method 3541, as specified in Table 6-12. The analysis method (Method 8082) employs GC utilizing an electron capture detector. Copies of the laboratory SOPs for the analytical and extraction methods are included in Appendix B of this SRIWP. The specific TCL and SQL requirements are specified in Table 6-3.

Detected Aroclor PCBs will undergo confirmatory analysis on a chemically dissimilar second column. Fully compliant analyses, including QA/QC check standards, will be processed for both primary and confirmatory analyses. An MS for Aroclor PCBs will be performed by spiking with Aroclor 1254. Details of the analytical procedure are presented in Appendix B of this SRIWP.

The limits for MS/MSD accuracy and precision for specific Aroclor PCBs in tissue samples are laboratory-specific and will be developed following the procedures listed in Method 8000B (Appendix B). Likewise, surrogate %R limits will be developed following the procedures outlined in Method 8000B. For the MS, MSD, LCS, and surrogate limits, the laboratory's in-house statistically derived limits will be used.

6.3.2.6 PCDDs/PCDFs

PCDDs/PCDFs in tissue samples will be analyzed by Method 1613, Revision B (1613B), October 2001, as specified in Table 6-12. A copy of the laboratory SOP for this analytical method is included in Appendix B of this SRIWP. This method uses HRGC/HRMS in the SIM mode for the detection and quantitation of PCDDs (tetra through octachlorinated homologues) and PCDFs (tetra through octachlorinated homologues) at ppt concentrations for tissue samples. USEPA Method 1613B is considered preferable to SW-846 Method 8290. Method 1613B incorporates additional labeled internal standards for 2,3,7,8-substituted isomers (except the octachlorinated dibenzofuran) providing more accurate and reliable results. The specific TCL and SQL requirements are specified in Table 6-7.

The limits for MS accuracy for PCDD/PCDF analyses in aqueous and sediment matrices will be developed in accordance with the analytical method and the laboratory's in-house statistically derived limits will be used. Labeled analog standards added to each sample prior to preparation for analysis will have calculated %R within the laboratory-specific acceptance range. Initial precision and recovery standards, OPR standards, and the calibration verification standards will fall will also be developed in accordance with the analytical method and the laboratory's in-house statistically derived limits will be used.

6.3.2.7 TAL Metals and Cyanide

As specified in Table 6-12, the CVAA technique (SW-846 7471A) will be used for mercury analyses in tissue samples. Inductively coupled plasma emission spectroscopy (ICP; SW-846 6010B) will be used to quantify the remaining metals. Colorimetric method 9012A will be used for cyanide. Copies of the laboratory SOPs for the preparation and analytical methods for TAL metals and cyanide are included in Appendix B of this SRIWP. The specific TAL and SQL requirements are specified in Table 6-8.

The limits for MS and LCS accuracy (%R) for TAL metals and cyanide in tissue samples should be laboratory-specific and developed according to USEPA SW-846 procedures. Likewise, analytical duplicate precision (RPD) acceptance limits are laboratory-specific and are developed according to USEPA SW-846 procedures. For the MS, and LCS limits, the laboratory's in-house statistically derived limits will be used.

6.3.2.8 Physical Parameters

Percent lipids for the tissue samples will be performed using the method specified in Table 6-12. Copies of the laboratory SOPs for this analysis are provided in Appendix B of this SRIWP. The specific SQL requirements for percent lipids are specified in Table 6-11.

6.3.3 Ecological Assessments

The following section describes the data quality measurements for the ecological assessments including the shoreline habitat characterization, benthic community analysis, and toxicity testing.

6.3.3.1 Shoreline Habitat Characterization

There are no accuracy or precision requirements for the shoreline habitat characterization since it is a qualitative effort based on field and literature observations.

6.3.3.2 Benthic Invertebrate Community Analysis

The laboratory procedures, including QA/QC protocols, for sorting, counting, and identification of benthic invertebrates are provided in Appendix B. QA/QC checks (e.g., 10 percent recounts, 10 percent identification verification) will include the precision of the sorting, counting, and identification phases. If there is disagreement of greater than 20 percent, then an additional QA/QC subsample will be enumerated. If disagreement is again in excess of 20 percent, then all of the samples in that batch will be re-enumerated.

6.3.3.3 Sediment Toxicity Tests

The toxicity of sediments collected in the field will be evaluated using a 28-Day Static-Renewal toxicity test with the estuarine amphipod *Leptocheirus plumulosus*. The laboratory procedures, including QA/QC protocols, are provided in Appendix B. These test procedures were developed to meet the standard procedures described in "Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-Associated Contaminants with the Amphipod *Leptocheirus plumulosus*" (USEPA 2001c). Performance standards are applied to laboratory control tests and include percent survival of adult amphipods in the control must be ≥ 80 percent after 28 days of exposure and measurable growth and reproduction must be observed in laboratory

control vessels. Test conditions and acceptability criteria for the 28-day *Leptocheirus plumulosus* toxicity test are presented in Table 6-13.

6.4 Quantitation Limits

The target analytes for each of the specified analytical methods and the required SQLs and method detection limits (MDLs) for each are listed in Tables 6-1 through 6-11.

With the exception of the PCDD/PCDF, metals, and cyanide analyses, the laboratory will demonstrate that the reporting SQL for each analyte on a "clean" matrix (i.e., blank) is less than or equal to the limits listed in Tables 6-1 through 6-11. The laboratory's SQL for each organic analyte will be substantiated by the laboratory's MDL for that analyte. No analytical results shall be reported as detectable if calculated concentrations are less than the laboratory's MDL. The laboratory will report non-detects for organics at the SQL. If the calculated concentration is greater than the MDL but less than the SQL, the positive value shall be reported and flagged (G).

For the TAL metals and cyanide analyses, the laboratory's SQL on a clean matrix for an analyte will be less than or equal to the required SQL for that analyte listed in Table 6-8. The laboratory will report non-detects for inorganics at the SQL. If the calculated concentration is greater than the MDL but less than the SQL, the positive value shall be reported and flagged (B).

The detection limits for PCDDs/PCDFs are sample-specific per the analytical method. The detection limits on a clean matrix will be less than the representative SQLs listed in Table 6-7.

Detection limits for PCDD/PCDF non-detect results are to be calculated in accordance with the following procedure:

1. Calculate a sample-specific estimated detection limit for each 2,3,7,8-substituted congener for which the Selected Ion Current Profile (SICP) indicated that any of the peaks was not found to be present with a signal to noise ratio greater than 2.5:1.

   Use the equation below to perform the estimated detection limit calculation:

   For Water/Liquid:

$$EstimatedDetectionLimit = \frac{2.5 \; x \; H_x \; x \; Q_{is}}{H_{is} \; x \; RR \; x \; V}$$

Where:

H_x = The height of the noise at the retention time of the quantitation ion of the 2,3,7,8-substituted congener of interest.

H_{is} = The peak height of the quantitation ion of the appropriate internal standard.

Q_{is}, RR, and V are the quantity of internal standard, the relative response, and the volume of sample, respectively.

2. Calculate an Estimated Maximum Possible Concentration (EMPC) for 2,3,7,8-substituted congeners that had signal to noise ratios for the quantitation and confirmation ions greater than 2.5:1, but for which interferences caused the result to fail some other qualitative identification criterion.

   Use the equation below to perform the EMPC calculations:

$$EMPC = \frac{A_x \; x \; Q_{is}}{A_{is} \; x \; RR \; x \; V}$$

   For Water/Liquid:

Where:

A_x = Area of the quantitation ion or confirmation ion for the 2,3,7,8-substituted congener of interest.

A_{is} = Area of the quantitation ion for the labeled compound.

Q_{is}, RR, and V are defined above.

Note: For the calculations of EMPC, the lower area of the quantitation or confirmation ion is used. The use of lower EMPC will more accurately reflect the possible concentration of the congener PCDDs/PCDFs.

7. Quality Control

Internal QC procedures are designed to document the overall quality of data. Two types of QC checks (field and laboratory) will be employed to evaluate the data quality. The QC checks represent the controlled samples introduced into the sample analysis stream that are used to validate the data and calculate the accuracy and precision of the chemical analysis program.

Field QC checks are accomplished by submitting controlled samples that are introduced to the laboratory from the field. Two types of control samples will be used: blanks (e.g., rinsate blanks) and field duplicates. Field duplicates are submitted “blind” to the laboratory. These blind samples will be noted in the logbook and given a unique sample number that does not indicate that the sample is a QC check.

Laboratory QC checks are accomplished through the analysis of initial and continuing calibration checks, blanks (laboratory method blanks), duplicates (laboratory replicates), calibration standards, spikes (surrogate spike, MS/MSD), and system performance checks (LCS, interference correction samples, etc.).

The level and types of QC check samples that may be introduced into the analytical program are described below. At a minimum, the QC required in the analytical methods will be followed by the laboratory. The QA/QC samples described will be included in every sample lot. An SDG will consist of no more than 20 samples of the same matrix for the organic, cyanide, and metals analyses, collected over a period of time not to exceed seven days. QA/QC samples, except those submitted "blind," should be excluded from the count of 20 samples.

For laboratory blanks, trip (volatiles only) blanks, and rinsate blanks in which "analyte-free" water is required, the following criteria for analyte-free reagents (e.g., water, Ottawa sand, solvent) shall be used:

Semivolatile Organics	<SQL
Pesticides	<SQL
PCB Congeners	<SQL
Chlorinated Herbicides	<SQL

TAL Metals (including Mercury) and Cyanide	<SQL
PCDDs/PCDFs	<SQL
Volatile Organics	<SQL
Conventional Parameters	<SQL
PCB Aroclors	<SQL
Hexavalent Chromium	<SQL
AVS/SEM	<SQL

7.1 Field QC Checks

The types of field QC samples to be collected as part of this SRIWP are listed in Table 7-1. The frequency of collection of field QC samples is shown in Table 7-2.

7.1.1 Rinsate Blanks

Rinsate blanks are blanks collected by pouring deionized, analyte-free water or solvent over the sampling equipment after it has been decontaminated and prior to use in the field. Rinsate blanks are often referred to as equipment blanks or as decontamination procedure blanks. Rinsate blanks are submitted for testing each type of sampling equipment used each day a decontamination event is carried out (not to exceed one per day). Rinsate blanks are used to check for sample contamination caused by reuse of decontaminated sampling equipment, as well as the sampling process and transportation. Rinsate blanks will be prepared using distilled deionized analyte-free water or solvent, whichever is appropriate for the COIs (i.e., solvent used in equipment decontamination process), as provided by the laboratories or obtained commercially (e.g., high-performance liquid chromatography water).

7.1.2 Field Duplicates

Field duplicates are prepared in the field to assess the precision of the sampling and analytical procedures. Field duplicates for sediment are prepared by homogenizing or mixing a double portion of a sample and placing equal aliquots of the homogenate into two separate sets of glassware. Homogenizing is inappropriate for the analysis of

volatile organics and AVS/SEM. In such cases, two sediment grab samples will be taken from the sampling location.

Sediment field duplicates will be submitted blind to the laboratory. The true identity will be thoroughly documented in the field notes, but this documentation is not submitted to the laboratory. Field duplicates will be collected at the frequency specified in Table 7-2. If the results of field duplicates differ dramatically (RPD >100 percent), an analytical problem may exist or the matrix is not homogeneous, and the data must be critically assessed.

For biological tissue samples, field duplicates will consist of a separate whole-body tissue sample and will be submitted to the laboratory with the other samples for analysis. On this basis, biological tissue samples field duplicate will not be submitted blind to the laboratory. Fish tissue will not be analyzed for volatile organics.

7.1.3 Trip Blanks

Trip blanks will be submitted to the laboratory when samples are analyzed for volatile organics. A trip blank consists of water obtained from the analytical laboratory and carried with the field sample bottles during the sampling event. When the sampling event has ended, the trip blanks are labeled and shipped to the laboratory along with representative field samples for volatile analyses only. Trip blanks will be processed at a frequency of one for each cooler shipped from the field to the laboratory that contains samples for volatiles analyses.

7.2 Laboratory QA/QC Checks

Laboratory QA comes both from strict adherence to the QA/QC measures inherent in the analytical methods used, and from adherence to an overall laboratory QA program. The laboratory QA program should specify that procedures, both technical and administrative, be documented as SOPs and disseminated to appropriate laboratory personnel. The QA program should also detail the mechanisms by which changes are incorporated into SOPs and the means by which revised SOPs reliably replace superseded copies. The program provides information on the analytical procedures conducted, documents that they were conducted according to sound scientific principles, and provides for systematic validation of analytical results. The QA program includes systematic monitoring of laboratory performance so that corrective actions can be taken as needed. The QA program also details the proper procedures for recording

and archiving data. It is the responsibility of the Laboratory QA Manager and Laboratory Director to implement the QA program and evaluate its effectiveness.

Laboratory QA procedures will be followed to document proper sample handling and tracking of analytical accuracy and precision. Proper sample handling procedures will be documented using logbooks for sample storage and transport as outlined in the laboratory SOPs. Accuracy will be evaluated using analyses of blanks, surrogate spikes, MSs, and LCSs, and precision will be evaluated using analysis of laboratory duplicates.

7.2.1 Method Blanks

Laboratory method blanks are prepared from analyte-free reagents, as demonstrated by laboratory analysis and carried through the identical preparation and analysis procedures as for samples submitted from the field for analysis. The purpose is to determine if potential sample contamination is occurring as an artifact of laboratory procedures. Laboratory method blanks will be analyzed at the frequency specified in the method, but at a minimum of one for each analytical batch of samples. (A batch is defined as a group of up to 20 samples of the same matrix, prepared at the same time, using the same procedure.)

7.2.2 Laboratory Duplicates

Laboratory duplicates are two portions of a single homogeneous sample that are analyzed for the same parameter to determine the precision of the analytical system. The analytical laboratory will perform duplicate analyses for the metals and cyanide methods specified in Table 6-12. Laboratory duplicates will be analyzed at the frequency specified in the method, at a minimum frequency of one for each analytical batch of samples. (A batch is defined as a group of up to 20 samples, of the same matrix, prepared at the same time, using the same procedure.)

7.2.3 Surrogate Spikes

Surrogate spikes are added to samples to be analyzed for organic contaminants where specified in the analytical method. Surrogate compounds are compounds not expected to be found in environmental samples; however, they are chemically similar to several compounds analyzed in the method. In the SW-846 method protocols, there are six semivolatile surrogates and three volatile surrogates that are added at pre-designated amounts for the appropriate analyses. Primary and alternate surrogate compounds are

recommended for pesticide, Aroclor PCB, and herbicide analyses in the respective methods.

A %R for the surrogates is calculated concurrently with the analytes of interest. Since the sample characteristics will affect the %R, the %R is a measure of accuracy of the analytical method on each individual sample (laboratory QC acceptance criteria for surrogate recoveries are given in the individual methods and as noted throughout Section 6.3).

7.2.4 Matrix Spikes

MS/MSD samples are analyzed for organics, while a MS (only) and laboratory duplicate sample are analyzed for metals, cyanide, and other inorganic compounds. Laboratory QC acceptance for MS/MSD samples are discussed throughout Section 6.3.

MS/MSD for organic compounds and MS for metals and cyanide are used to evaluate the effect of the sample matrix on the accuracy of the laboratory method. Known concentrations of analytes are added to environmental samples; the MS and MSD, are then processed through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as %R of the known amount spiked. For all organic analyses, MS/MSD %R values are further used to determine the precision of the analytical system. This determination is done by evaluating the RPD between the two %R values obtained for the MS/MSD pair.

MS/MSD or MS/Duplicate analyses will be performed at the method-specified frequency. The analytical laboratory will perform MS/MSD or MS/Duplicate analyses where appropriate at a minimum frequency of one for each analytical batch of samples. (A batch is defined as a group of up to 20 samples, of the same matrix, prepared at the same time, using the same procedure.)

7.2.5 Laboratory Control Samples

A clean laboratory matrix which is spiked with a known amount of a standard (or standards) is defined as an LCS. The LCS results provide an indication of the accuracy of the laboratory's analysis on standard materials. The analytical laboratory will perform an LCS analysis representing each target analyte group at a minimum frequency of one for every analytical batch of samples. (A batch is defined as a group of up to 20 samples, of the same matrix, prepared at the same time, using the same procedure.)

7.2.6 Performance Evaluation Samples

Two dioxin/furan performance evaluation (PE) samples were analyzed as part of the RI program (ARCADIS 2008). Additional PE samples for the Supplemental RI Program may be analyzed at the discretion of the FC. If requested, dioxin-specific PE samples (i.e., Standard Reference Materials [SRMs]) representing a solid sample matrix would be purchased from a commercial vendor. The PE samples would contain various target dioxin/furan isomers described herein at known and certified reference concentrations.

Two PE samples would be submitted blind to the laboratory prior to the start of the RI. One PE sample would contain known and certified concentrations of dioxin/furan isomers, while the other would be a certified blank material. Analytical results for the two PE samples would be supplied by the laboratory prior to field mobilization. PE sample concentrations reported by the laboratory would then be compared to certified reference acceptance ranges supplied by the vendor. These evaluations would serve as a demonstration of the laboratory's ability to apply the specified analytical methodology to the solid sample matrix with defined and acceptable accuracy.

7.2.7 Laboratory QA/QC Documentation

QA/QC procedures followed in the laboratory will be documented through the use of logbooks and system audits. Logbooks will be provided for sample handling, instrument monitoring and calibration, preparation of standards, and receipt of chemicals and supplies. Out-of-compliance occasions will be logged by the Laboratory QA Manager, with corrective actions described and resolution of the out-of-compliance situation noted as to time, date, and effectiveness. Raw and reduced data necessary to evaluate analytical QA will be stored by the laboratory in accordance with method SOPs and the laboratory's QA program. Project records will be available for on-site inspection during the course of the investigation. The laboratories will have SOPs in place for all phases of laboratory operations and analytical methods. The SOPs will be available for on-site review by non-laboratory personnel during the course of the investigation.

7.3 Instrument/Equipment, Inspection, Maintenance, and Calibration

Field equipment inspection, maintenance, and calibration schedules will be developed for both field and laboratory instruments. A summary of the testing, inspection, maintenance, and calibration activities to be performed is presented below.

7.3.1 Field Instruments and Equipment

Prior to field sampling, field equipment will be inspected to verify it is operational. If the equipment is not operational, it will be serviced prior to use. Meters or batteries that require charging will be charged or fresh disposable batteries will be used. If instrument servicing is required, it is the responsibility of the appropriate field personnel to follow the maintenance schedule and arrange for prompt service. Table 7-3 presents an equipment maintenance log that will be used to track the inspection and maintenance of each piece of field equipment used during SRIWP activities.

Field instrumentation to be used in this study includes such items as:

- Tide gage to measure water surface elevation
- DGPS to determine horizontal location
- Fathometer to measure water depth
- PID to measure volatile organics
- Electronic scale to weigh fish

Records of operation, maintenance, calibration, problems, and repairs will be maintained in a logbook as described in SOP No. 1 – Field Documentation. Field supervisors will review equipment calibration and maintenance logs.

Field equipment returned from the site will be inspected to confirm it is in working order. This inspection will be recorded in a logbook, as appropriate. It will be the obligation of the last user to record equipment problems in the logbook. Non-operational field equipment will be either repaired or replaced. Appropriate spare parts, batteries, and/or battery chargers will be made available for field instruments.

7.3.2 Laboratory Instruments and Equipment

Laboratory instrument and equipment maintenance procedures are provided in the laboratory's QA manuals and associated laboratory SOPs. Documentation will include details of observed problems, corrective measures, routine maintenance, and instrument repair, including information regarding the repair and the individual who performed the repair.

Preventive maintenance of laboratory equipment will follow the guidelines recommended by the manufacturer. A malfunctioning instrument will be repaired immediately by in-house staff or through a service call from the manufacturer. Maintenance schedules for laboratory equipment will adhere to the manufacturer's recommendations. Records reflect the complete history of each instrument and specify the time frame for future maintenance. Major repairs or maintenance procedures will be performed through service contracts with the manufacturer or qualified contractors. At a minimum, paperwork associated with service calls and preventive maintenance calls will be kept on file by the laboratory.

The laboratory analysts are responsible for the routine maintenance of instruments used in a particular laboratory. Routine preventative maintenance carried out will be logged in appropriate logbooks. The frequency of routine maintenance will be dictated by the nature of samples being analyzed, the requirements of the method used, and the judgment of the analysts and department managers.

Major instruments will be backed up by comparable (if not equivalent) instrument systems to avoid unscheduled downtime. An inventory of spare parts will also be available to minimize equipment/instrument downtime.

7.3.3 Field Equipment Calibration

Field equipment will be calibrated in accordance with the manufacturer's operating manuals or as specified in the SOPs. Table 7-4 presents a calibration schedule for field equipment. Field instruments will be used by experienced operators familiar with field procedures and manufacturer's instructions. The general calibration procedures will conform to manufacturer's standard instructions.

Calibration provides confidence that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Calibration data will be maintained by the Field Supervisor in a logbook and will be subject to audit by the QAC. Copies of instrument manuals will be maintained at the site as necessary for reference.

7.3.4 Inspection/Acceptance of Supplies and Consumables

Standards, solvents, and reagents will be logged and dated upon receipt. Standards will be discarded (according to SOP No. 13 – Management and Disposal of Residuals) after the maximum recommended holding time has expired or when analysis indicates

that the standard has degraded beyond acceptable tolerances. Solvents and reagents will be used on a revolving "first in, first out" basis to minimize storage time and the potential for degradation and/or contamination.

Solvents and reagents may be tested, through the use of method blanks, to assess the presence or absence of contaminants and interferents. If contamination is noted, confirmatory analyses will be performed. If the contamination is confirmed, the lot will be discarded.

7.3.5 Non-direct Measurements

Data produced from previous investigations in the HRSA are provided in the HRSA RI Report and were used to assist in designing this sampling program. The quality and usability of this (and other) historical data will be discussed as part of the deliverable from this SRIWP.

8. Data Management and Review

8.1 Version Control

To provide appropriate project personnel with the most current and updated version of the SRIWP, individuals identified on the distribution list will receive updates or subsequent versions with instructions on what to do with previous documents in their possession (e.g., consider new information an update, dispose of superseded version). Use of the form of header shown on this SRIWP (which contains a revision number and date) will ensure consistency and currency of document distribution. This same control procedure will be used for other reports generated as part of the RI Program.

8.2 Project Files

Project documentation will be placed in a central project file (known as the Hackensack River Central Project File). This file will be maintained and controlled by the Lead Consultant, and will consist of the following components:

1. Agreements (filed chronologically)

2. Correspondence (filed chronologically)

3. Memos (filed chronologically)

4. Notes and Data (filed by topic)

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation (when received) and field data will be filed with notes and data.

Duplicate copies of pertinent field-related correspondence/documentation will be maintained at the field office during field operations. Once such field operations have been completed, this documentation will be transferred to the Hackensack River Central Project File.

8.2.1 Sample Collection Reports

During implementation of the program, logbooks will be maintained in the field according to SOP 1 – Field Documentation, and Section 4.6 of this SRIWP. Field crews will document, at a minimum, activities performed, type and identification

number of samples collected, equipment and sampling method used, meteorological conditions, and difficulties or unusual observations observed in the field. QC samples collected will also be recorded in the logbook, including type (e.g., field blank, duplicate) and preservation methods used.

Chain-of-custody records will be completed and included with the samples submitted for laboratory analysis. Additional information on chain-of-custody requirements is provided in Section 4.8.2.

8.2.2 Laboratory Reports

The laboratory will prepare and retain full analytical and QC documentation. The laboratory will report the data as a group of 20 environmental samples (including blanks, duplicates, as appropriate) or fewer, along with QC supporting data. These groupings of samples (Sample Delivery Groups [SDGs]) will be assigned by the field sample collection and processing team.

For each analysis type, the laboratory will, at a minimum, provide the hard copy information listed below in each analytical data package submitted using CLP-equivalent forms. These forms shall contain information contained on the CLP forms that are pertinent to the analytical method requirements including, but not limited to, the following:

- Case Narrative: cover sheet listing the samples included in the report and narrative comments describing problems encountered in analysis; identification of analyses not meeting QC criteria (including holding times); listing of samples that need corrective action and what corrective action was taken (e.g., re-analysis); and copies of correspondence related to the samples in the package, including chain of custody documents. Case narratives submitted with each data package will include a summary of the analytical methods performed. These summaries will describe, at a minimum, the details of any optional processes allowed within USEPA or other standardized procedures that were applied to samples within each delivery group.

- Analytical results for QC sample spikes, sample duplicates, initial calibration, and continuing calibration verifications of standards and blanks, standard procedural blanks, and LCSs.

- Tabulated results of compounds identified and quantified dilution factors, the SQLs (i.e., reporting limits), and MDLs for all analytes. Organic analytes detected below the SQL, but above the MDL, will be reported with a "G" flag, and organic analytes detected below the SQL and MDL will be reported as non-detects and qualified as "U" at the SQL. Inorganic analytes detected below the SQL, but above the MDL will be reported with a "B" flag, and inorganic analytes detected below the SQL and MDL will be reported as non-detects and qualified as "U" at the SQL.

- Summary reports for initial and continuing calibrations listing relative response factors and percent relative standard deviations (%RSD) for organics, and %R and true values for metals; MS/MSD %R and %RSD for organics, and MS recoveries and spike amounts for metals; surrogate spike %R and spike amounts (if applicable); internal standard recoveries; laboratory blank results, and a method blank summary listing method blanks and associated samples; and LCS results (if applicable).

- Raw data system printouts (or legible photocopies) and chromatograms (identifying sample identification, date of reported analysis, parameters analyzed) for samples, initial calibration, calibration verifications, method blanks, any reported sample dilutions, sample duplicates, spikes, and control samples; sample spiking concentrations; and preparation/extraction logs and run logs.

The GC/MS displays for the PCDD/PCDF and PCB congeners and homologues analyses will include the standard and sample SICP chromatograms as specified in the analytical method with the date and time of analysis, file name, sample number, and instrument ID number. The SICP mass chromatograms will also have the quantitation ion and confirmation ion displayed, integrated area, and peak height listed for peaks 2.5 times above background. In addition, peaks will show retention time at the maximum height.

Laboratory data qualifiers will be provided by the analytical laboratory. These qualifiers will be consistent in definition and application with those currently residing in the comparison database. The standardized laboratory data qualifiers to be used during laboratory data reporting are provided in Table 8-1. Standardized laboratory data qualifiers allow for more accurate data comparisons when evaluating multiple data sets.

8.3 Data Reporting Formats

Analytical results will be obtained from laboratories in electronic and hard copy format. Upon receipt from the laboratory, these results will be validated as described in Section 8.5.2. Once validated, the electronic laboratory data will be placed in the project database. An internal check will be performed on data transfer to optimize accuracy. The database will be maintained in a central location. Alterations to the database will be checked accordingly.

Electronic deliverables are required of the laboratory. These deliverables will be submitted along with the hardcopy data package reports described earlier, and will be in Microsoft Excel spreadsheet format. Table 8-2 is an example of the format to be provided in the laboratory electronic deliverable.

8.4 Data Handling and Management

Data management is crucial in the organization of the project data and information. Field data, including weather conditions, air temperature, field personnel, field equipment, field equipment calibration, sample collection, and sample coordinates, will be recorded daily in the logbook. Field documentation will be completed as per SOP No.1 – Field Documentation. As appropriate, field data will be transferred to electronic form and maintained in a project database.

8.5 Data Evaluation

The analytical data generated by the laboratories will be evaluated to assess specific precision, accuracy, completeness, representativeness, and comparability criteria, as described in Section 6.2 of this document.

The validation results will be used to provide an evaluation of the overall laboratory performance based on the following data quality parameters:

- Precision of analysis through evaluation of matrix duplicate or MSD analytical results as specified in Section 6.2.1

- Accuracy through evaluation of spike sample recoveries, LCS analyses, and surrogate spike recoveries as specified in Section 6.2.2

- Representativeness through adherence to sampling procedures described in Section 6.2.3
- Completeness through evaluation of the overall field completeness and the overall analytical completeness as specified in Section 6.2.4
- Comparability through evaluation of sample-specific reporting limits, units of measure, and adherence to specified analytical methodologies as specified in Section 6.2.5

8.5.1 Data Verification Methods

The first level of data review, which may contain multiple sublevels, will be conducted by the analytical laboratory data reviewer. This individual (or individuals) has the initial responsibility for the correctness and completeness of the data. The laboratory data reviewer will evaluate the quality of the analytical data based on an established set of laboratory guidelines and this document.

The individual will review the data packages to confirm the following:

- Sample preparation information is correct and complete
- Analysis information is correct and complete
- The appropriate SOPs have been followed
- Analytical results are correct and complete and results are reported using proper units
- QC samples are within established control limits
- Blanks are within appropriate QC limits
- Analytical results for QC sample spikes, sample duplicates, initial and continuing calibration verification of standards and blanks, standard procedural blanks, LCSs, serial dilutions, and inductively coupled plasma interference check samples are correct and complete
- Tabulation of reporting limits related to the sample are correct and complete

- Special sample preparation and analytical requirements have been met

- Documentation is complete (anomalies in the preparation and analysis have been documented; holding times are documented)

The laboratory will perform the in-house analytical data verification steps under the direction of the laboratory data review supervisor. The laboratory is responsible for assessing data quality and advising the QAC of data rated "preliminary" or "unacceptable," or other notations that would caution the data user of possible unreliability. Data verification performed by the laboratory will be conducted as follows:

- Raw data produced by the laboratory analyst will be processed and reviewed for attainment of QC criteria as outlined in this SRIWP and/or established NJDEP methods for overall reasonableness

- The laboratory's data reviewer will check sample data entered manually for entry errors and will check data electronically uploaded from the instrument output into the software packages used for calculations and generation of report forms for transfer errors and decide whether sample re-analysis is required

- The laboratory will review initial and continuing calibration data, calculation of response factors, surrogate and system monitoring compound recoveries, MS/MSD recoveries, sample spike recoveries, post-digestion spike recoveries, internal standard recoveries, LCS recoveries, and sample results

- Upon acceptance of the preliminary reports by the laboratory's data reviewer, the Laboratory QA/QC Manager or designee will review and approve the data packages prior to generation of the final reports

The data verification steps will be documented, signed, and dated by the individuals responsible for each task.

8.5.2 Data Validation Methods

The second level of data review is validation. Data validation will be performed by a designee of the Auditor, whose function is to provide an independent review of the data package. This process will include review of project data quality measurement

parameters (Section 6.2), in addition to the completion of specific data validation procedures described below.

The QA/QC methodologies specified in this SRIWP are based on those set forth in SW-846. This document was prepared taking into consideration the USEPA Region 2 CERCLA Quality Assurance Manual (USEPA 1989c), which recommends the use of SOPs for data validation.

ESI of Valley Forge, Pennsylvania will validate all data generated and will produce a Data Validation Report for each individual SDG using the most recent versions of the USEPA Region 2 method-specific SOPs for data validation, and the USEPA's National Function Guidelines (USEPA 1999; 2002b) available at the time of project initiation, where appropriate.

USEPA Region 2 does not provide validation SOPs for hexavalent chromium, PCB congeners, TEPH, TOC, or other non-SW-846 analyses. Therefore, professional judgment will be used in evaluating the data where no specific data validation SOPs exist. However, hexavalent chromium data validation will follow the validation procedures in accordance with the Remedial Investigation Work Plan Quality Assurance Project Plan for the Remedial Investigation of Chromite Ore Processing Residue Sites in New Jersey (Designated Under NJDEP April 17, 1990 ACO).

Special consideration will be given to the validation of metals and cyanide data. The metals and cyanide analysis validation SOP referenced in the USEPA Region 2 manual is specifically designed for the QA/QC methodologies and analytical methods specified in the USEPA CLP Statements of Work, rather than those in SW-846. Therefore, the QC limits specified in the analytical methods will replace the control limits in the SOP. If a validation question in the USEPA Region 2 SOP checklist refers to similar processes (in CLP versus the analytical method) with somewhat differing protocols, such as calibration requirements, the validation question will be evaluated with respect to the analytical method requirements.

Upon completion of data validation, the data packages, data summary sheets, data assessment narratives, and data assessment checklists will be placed in the Hackensack River Central Project File (Section 8.2). As part of the data validation process, the following validation qualifiers and their meanings will be used.

'U' Non-detect – The analyte was analyzed for, but was not detected above the reported SQL.

‘J’ Estimated value – The analyte was positively identified, but the associated numerical value is the approximate concentration of the analyte in the sample.

‘NJ’ The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

‘UJ’ Estimated non-detect – The analyte was not detected above the reported SQL. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

‘R’ The sample results are rejected – Due to significant QA/QC problems, the analysis is invalid and provides no information as to whether the analyte is present or not. Once the data are flagged with an 'R,' further review or consideration is unnecessary.

‘M’ The analytical result reported was obtained from a sediment sample found to contain between 50 and 90 percent moisture and had no other data qualifiers added during the data validation process.

If no determination of the overall bias of a result qualified as estimated can be made, the result will be qualified with a ‘J.’ If the data reviewer can determine the overall bias for sample data qualified as estimated, the data reviewer will qualify the sample result as either an estimated minimum value (JL) or an estimated maximum value (JH). The JL qualifier can also be applied to non-detect results. In addition, the ‘D’ qualifier can be added to the ‘J,’ ‘JL,’ ‘JH,’ or ‘NJ’ qualifiers to indicate that the reported result is from a diluted analysis.

One hundred percent of the data on the summary forms for each data package will be checked back to the raw data for potential calculation errors, transcription errors, and data transfer errors. If the initial validation efforts indicate that no significant problems are being encountered with respect to the laboratory performance criteria for a given laboratory, it may be requested of NJDEP that review of these criteria on the remaining data not be required.

8.5.3 Data Usability Assessment

Project operations will be continually reviewed to assess data quality and adherence to the requirements outlined in this document. This will be accomplished using the mechanisms previously described such as data verification and data validation, as well as performance audits, systems audits, and professional judgment (refer to Section 9). The focus of these audits and assessments is to determine whether objectives outlined in this SRIWP and project-specific DQOs are being met, or that appropriate corrective actions are implemented to correct non-compliant situations. Each of the monitoring steps will be carefully documented so that the data user can consider assessment findings and data qualifications when using the information for decision-making purposes.

The data results will be examined to determine the performance that was achieved for each data usability criteria. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results, or inconsistent data may include any or all of the following:

- Retrieval of missing information
- Request for additional explanation or clarification
- Re-analysis of sample from extract (when appropriate)
- Recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty, and may eliminate the need to qualify or reject data. If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- Extrapolation of missing data from existing data points
- Use of historical data
- Evaluation of the critical/non-critical nature of the sample

If the data gap cannot be resolved by these actions, an evaluation of the data bias and potential for false negatives and positives can be performed. If the resultant uncertainty level is unacceptable, additional sample collection and analysis must be performed.

Upon completion of data acquisition tasks, a thorough summation of data quality measurement parameters (Section 6.2) will be prepared based on the actual outcome of each parameter in the sampling program. Additionally, specific calculations will be presented describing achieved percent field completeness, as well as percent analytical completeness. Summarized data quality parameter outcomes, as well as the documentation of monitoring steps used during data generation activities, will be employed by the data user to reconcile results obtained with user requirements.

9. Assessment and Oversight

Data quality will be assessed through implementation of performance audits and systems audits. The QA program operates independently of the overall project structure to provide an effective check and review of work plans, reports, and calculations.

9.1 Performance Audits

Performance audits are used to quantitatively assess the accuracy of measured data through the use of performance evaluation and blind check samples. Such performance audits (e.g., field duplicate and PE samples) are described in Section 7 of this SRIWP.

9.2 Systems Audits

Systems audits generally consist of a review of the field and laboratory QA systems and physical facilities for sampling, calibration, and measurement. These systems audits will be performed by a qualified individual (i.e., Auditor) associated with the Lead Consultant. NJDEP may also perform systems audits at their discretion. Systems audits are conducted to determine whether:

- The QA program has been documented in accordance with specified requirements
- The documented QA program has been implemented
- Instances of non-conformance have been identified and corrective action(s) have been implemented

The Auditor (may be more than one individual) will conduct field audits to coincide with appropriate activities on this project, as described in this section. It is anticipated that one or more field audits will be conducted during sample collection activities. Laboratory systems audits are anticipated to consist of verifying that the laboratories contracted to perform the SRIWP activities are properly accredited and have the necessary certification to conduct their respective analytical program. Field and laboratory audits will be conducted under the direction of the FC.

The systems audit may include review of project files, document tracking processes, and individuals performing field work and report preparation. Systems audits may

review the total data generation process, which includes on-site review of the field operational systems; physical facilities for sample processing, sample collection, and tracking; equipment calibrations; and the procedures field and laboratory staff used to generate acceptable data.

9.2.1 Onsite Field Audits

The field audit may be conducted by someone familiar with the technical and procedural requirements of field sampling and the applicable work plan requirements. The Auditor will maintain a record of the evaluation by preparing written documentation of the audit. Following the audit, preliminary results will be reviewed with the person in charge of the sampling.

The following are specific areas that may be evaluated in a given field audit:

- Sample labels
- Chains-of-custody
- Sampling operations
- Equipment operations and calibrations
- Document control

The Auditor will review sampling operations to determine if they are performed as stated in this document. The Auditor will evaluate whether the samples are in proper containers and are properly preserved. The Auditor will also evaluate whether the required field observations and QA checks have been performed and documented as directed.

The document control audit will consist of checking “sample” documents for accountability. Documents used for field activities will be checked against the list of field documents required as part of this SRIWP. At the conclusion of the audit, the audit report or post-audit confluence will be held amongst the FC and Lead Consultant PM.

9.2.2 Laboratory Audits

An on-site laboratory audit helps discern whether the necessary QA/QC practices are employed by the laboratory in order to deliver a product of the expected quality. Audits of the two primary chemical analytical laboratories (Vista Analytical and TestAmerica) were previously conducted during the RI; therefore, additional audits are not planned during this supplemental investigation. Laboratory audits, however, may be performed in advance of using a given chemical testing laboratory at the discretion of the FC.

Laboratory audits may include an evaluation of whether the following criteria are met:

- The organization and personnel are qualified to perform assigned tasks
- Adequate facilities and equipment are available
- Complete documentation, including chain of custody of samples and internal sample tracking measures, are being implemented
- Required analytical methodologies are being used
- Adequate analytical or testing QC and calibration (including reference samples, control charts, and documented corrective action measures) are being provided
- Acceptable data handling, documentation techniques, and data review are being used

Copies of relevant and current state certifications and performance evaluations for parameters of interest may be obtained from the laboratory and reviewed during the audit.

At the conclusion of the audit, the Auditor may hold a post-audit conference with the Laboratory Manager, Laboratory Supervisor, or designated representative to present audit findings and clarify misunderstandings.

9.3 Corrective Actions

Instances of non-conformance and issues requiring corrective action identified by the Auditor during performance audits, systems audits, or data evaluation activities will be communicated to the audited entity. A corrective action is a change in field or

laboratory procedure that is designed to bring the practice into compliance with the QA objectives. However, a corrective action can also include changes that will improve or modify procedures presented in this SRIWP if procedures are inadequate to provide guidance for unforeseen circumstances. The purpose of a corrective action is to ensure that data of known quality are generated, and that procedures followed are in accordance with this document.

9.3.1 Field Corrective Actions

Corrective action resulting from field audits or other sources identifying the need for corrective action will require notification of the FC, Lead Consultant PM, and Auditor. The actions taken should be noted in the field book and all corrective actions will be described on a corrective action form (CAF) similar to Figure 9-1, which is to be approved by the FC and Auditor. If corrective action does not solve the problem, appropriate personnel will be assigned to investigate and evaluate the cause of the problem. Once a corrective action is implemented, the effectiveness of the action will be verified.

The corrective actions documented in the final report CAF will include a description of the deviation and the date(s) of the deviation, the reference to the affected section(s) of the project plans, and resolution of the deviation. A CAF prepared for this project will be included in the QC summary submitted with the HRSA Supplemental RI Report.

Contingency plans or corrective actions may include, but are not limited to, the following actions:

- Re-sampling of potentially affected samples
- Discarding potentially affected samples or data
- Accepting samples or data with an acknowledged level of uncertainty or error
- Correcting or amending sampling or measurement procedures

Data that are deemed unacceptable following implementation of the contingency plan or corrective action will not be used for final data analysis. The corrective actions described in this section do not necessarily require SOP modifications. Should the need for significant SOP changes be identified, the FC will contact the NJDEP SM and request formal approval for such a change(s).

9.3.2 Laboratory Corrective Actions

Corrective action resulting from laboratory audits or other sources identifying the need for corrective action will be initiated by the Laboratory QA/QC Manager in consultation with the Auditor, documented on forms such as that on Figure 9-1, and approved by the Lead Consultant PM, QAC, and Auditor. Corrective actions identified by the laboratory will be reported to the Auditor, QAC, and Lead Consultant PM for review prior to implementation. If the corrective action requires a substantial modification, such proposed modification will be submitted to NJDEP for approval. Corrective actions may include, but are not limited to, the following:

- Correcting laboratory procedures
- Accepting data with an acknowledged level of uncertainty
- Recommending re-sampling and re-analysis

Whenever corrective action is necessary to eliminate the cause of a non-conformance, as appropriate, the Auditor, QAC, or Lead Consultant PM will ensure that appropriate steps are followed. For example:

- The problem will be defined
- Responsibility for investigating the problem will be assigned and accepted
- The cause of the problem will be investigated
- A corrective action to eliminate the problem will be identified
- Responsibility for implementing the corrective action will be assigned and accepted
- The effectiveness of the corrective action will be evaluated
- Substantive modification of the approved SRIWP shall be submitted in writing for NJDEP approval
- The effectiveness of the corrective action will be verified

9.3.3 Immediate Corrective Actions

Equipment or instrument malfunction will require immediate corrective action. Field and laboratory QC measures and QA plans are working tools used to identify appropriate immediate corrective actions to be taken when non-conformance to plans or QC limits are encountered. They provide the framework for uniform actions as part of normal operating procedures. Immediate concerns will be addressed in the field or laboratory right away (with PM notification). All personnel on site have the right to execute a “stop work” order if unsafe conditions exist and require corrective action. Immediate corrective actions taken will be applied on a daily basis as necessary, and will be recorded in the logbooks.

10. Deliverables

Following receipt and validation of the SRIWP data, the Group proposes to complete two technical memoranda to summarize and present the results of the Supplemental RI. One technical memorandum will describe the results of the BERA and one technical memorandum will describe the results of the nature and extent of sediment quality in the HRSA and background locations.

The group proposes to submit the technical memoranda to NJDEP for review and to hold a meeting to review the results of the investigation. Considerations to be evaluated during the meeting will include overall compliance of the results of the Supplemental RI Program with the DQOs established in this SRIWP, the potential need to collect additional data, and concurrence on a path forward.

Once concurrence that sufficient data has been obtained to meet the objectives of the SRIWP, the Group will prepare the HRSA Supplemental RI Report. This report will provide the overall results of the supplemental nature and extent sampling, background/reference area investigation, and BERA.

11. Permitting and Schedule

This section outlines permits anticipated to be required to complete this work and presents scheduling information related to the planning and implementation of the SRIWP.

11.1 Permits

Sampling activities in the HRSA require permitting under the Waterfront Development Law (N.J.S.A. 12:5-3). An application for Coastal General Permit 27 (CGP 27) for survey borings will be submitted to the NJDEP Division of Land Use Regulation for authorization to advance cores to evaluate sediments.

Relevant permits will be obtained for all biological tissue collection. The following agencies will be consulted to confirm conformance to the Endangered Species Act, Fish and Wildlife Coordination Act, Magnuson-Stevens Fishery Conservation and Management Act and other applicable regulations:

- National Marine Fisheries Service
- U.S. Fish and Wildlife Service
- New Jersey Department Office of Natural Lands Management

Sampling activities will not commence prior to approval of the appropriate permit by NJDEP and response from the above agencies.

11.2 Schedule

The schedule for the implementation of the SRIWP considers the season during which activities proposed in the BERA can be implemented in view of the need to collect fish tissue samples outside of the spawning and breeding season and to avoid timing restrictions associated with fish migration. The spawning and breeding season should be avoided due to variability in the fish's diet, fat content, and respiration rate, which can all affect chemical uptake and excretion. In view of these considerations, the appropriate period to implement work proposed in this SRIWP is from late summer through early fall (i.e., August through October), when the lipid content of many species is generally highest and freshwater levels are typically lower, which facilitates sample collection (NJDEP 1998).

The schedule includes a 90-day period for NJDEP review and approval of this SRIWP. Following approval of the SRIWP, the Group will select background/reference area sampling locations and seek approval of these locations from the NJDEP. Following approval of the background/reference area sampling locations, the necessary permits required for this work will be obtained. It is anticipated that it will take 60 days to prepare and submit necessary permits to NJDEP and that permit approval will be obtained 90 days after submittal. The Group will work as expeditiously as possible to secure necessary permits pending approval of the SRIWP and background/reference area sampling locations.

Once the permits are in place, the Group will implement planning and pre-mobilization activities, which are anticipated to last 60 days. Final planning and mobilization activities are anticipated to require 30 days preceding the actual field work. Laboratory analyses and data validation are anticipated to require 90 days pending completion of the field sampling program. The Group anticipates that data review and preparation of the technical memoranda will require 90 days pending completion of data validation.

The Group will then seek to schedule a meeting with NJDEP to review the data obtained during the Supplemental RI and establish a path forward. Following the meeting and NJDEP's approval, the Group will prepare a Supplemental RI Report. The anticipated schedule to complete the Supplemental RI Report is 90 days. In the event that the need for additional work is identified and agreed upon during the meeting, the Group will propose a revised schedule to the NJDEP. Figure 11-1 depicts an estimated project schedule.

12. References

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Tables

Table 1-1
USEPA QA/R-5 Elements and HRSA SRIWP Cross-Reference Table

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

QA/R-5 Element		SRIWP Corresponding Location	Page Number
A1	Title and Approval Sheet	Inside Front Cover	Inside Front Cover
A2	Table of Contents	Front Portion	i
A3	Distribution List	Inside Front Cover	Inside Front Cover
A4	Project/Task Organization	Section 5	5-1
A5	Problem Definition/Background	Sections 1 and 2	1-1
A6	Project/Task Description	Section 3	3-1
A7	Quality Objectives and Criteria	Section 6	6-1
A8	Special Training/Certification	Section 5.2.5	5-3
A9	Documents and Records	Section 8	8-1
B1	Sampling Process Design	Section 4	4-1
B2	Sampling Methods	Section 4	4-1
B3	Sample Handling and Custody	Section 4.8	4-14
B4	Analytical Methods	Section 6.3	6-6
B5	Quality Control	Section 7	7-1
B6	Instrument/Equipment, Inspection, and Maintenance	Section 7.3	7-6
B7	Instrument/Equipment Calibration and Frequency	Section 7.3.3	7-8
B8	Inspection/Acceptance of Supplies and Consumables	Section 7.3.4	7-8
B9	Non-Direct Measurements	Section 7.3.5	7-9
B10	Data Management	Section 8	8-1

Table 1-1 (cont'd)
USEPA QA/R-5 Elements and HRSA SRIWP Cross-Reference Table

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

QA/R-5 Element		SRIWP Corresponding Location	Page Number
C1	Assessments and Response Actions	Section 9	9-1
C2	Reports to Management	Section 8.3	8-4
D1	Data Review, Verification, and Validation	Section 8.5	8-4
D2	Verification and Validation Methods	Section 8.5	8-4
D3	Reconciliation with User Requirements	Section 8.5.3	8-9

Table 3-1
Supplemental RI Tasks and Associated Data Uses

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Tasks	Sampling Area/Core Length	Parameter	Number of Locations/Samples	Data Use
Core Sampling – Analytical Testing	4 ft Cores	Samples will be analyzed for PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, VOCs, PCDD/PCDFs, TOC and hexavalent chromium. Grain size, pH, ORP and percent moisture will also be assessed.	11 locations (9 in the HRSA, 2 in the upstream reference area) have been proposed in which a 4-ft core will be collected. The 4-ft cores will be segmented into three sediment samples (0-0.5 ft, 0.5-2 ft and 2-4 ft).	Supplemental nature and extent Background investigation BERA
	20 ft Core		One location has been identified in the HRSA in which a 20 ft core will be collected. The 20-ft core will be segmented into 4 sediment samples (12-14 ft,14-16 ft, 16-18 ft and 18-20 ft).	
	Oil-like Substance Delineation Cores	Samples will be analyzed for PAHs, TEPH, TOC, pH and grain size.	Various cores surrounding 3 RI sampling locations in the HRSA will be collected to delineate oil-like substances.	
Surface Sediment Sampling – Analytical Testing	Mudflats and Subtidal Areas - Surficial Grab Samples	Samples will be analyzed for PCB Congeners and Homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, VOCs, PCDD/PCDFs, TOC and hexavalent chromium. Grain size, pH, ORP, AVS/SEM and percent moisture will also be assessed.	5 mudflats have been identified for sampling: 1 large mudflat will be subdivided into 2 sampling locations; 4 smaller mudflats will have 1 sampling location each, for a total of 6 mudflat sampling locations. In addition, 4 subtidal areas of the HRSA will have 1 sampling location from each area. In the upstream reference area, 2 large mudflats will be sampled as well as 1 subtidal station.	Supplemental nature and extent Background investigation BERA
Surface Sediment Sampling – Ecological Components		Bulk surface sediment samples will be collected for toxicity testing and benthic community analysis.	10 sampling locations in the HRSA have been identified to collect sediment for toxicity testing and benthic community analysis. 6 sampling locations along the mudflats and 4 subtidal locations will be used to collect 3 sediment samples each for benthic community analysis. The same stations will be used to collect one sample each for toxicity testing. In the reference area, sediment for toxicity testing and benthic community analysis will be collected from 3 locations - 2 from mudflats and 1 from a subtidal area.	Background investigation BERA

Table 3-1
Supplemental RI Tasks and Associated Data Uses

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Tasks	Sampling Area/Core Length	Parameter	Number of Locations/Samples	Data Use
Biological Tissue Sampling – Analytical Testing	Mudflats - Resident Fish and Blue Crab Collection	Samples will be analyzed for PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide and PCDD/PCDFs. Total lipids will also be assessed.	6 sampling locations in the HRSA along 5 mudflats have been identified in the HRSA to sample biological tissue. 1 composite mummichog and blue crab sample will be collected from each location. In addition, 1 composite mummichog and blue crab sample will be collected from 3 sampling locations (2 mudflats, 1 subtidal area) in the upstream reference area.	Background investigation BERA
	Deeper Channel Areas - Predatory Fish Collection		2 transects will be sampled for large upper-trophic level predatory fish. 8 fish tissue samples will be collected from each transect for a total of 16 fish samples in the HRSA.	BERA

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted metals
BERA = Baseline Ecological Risk Assessment
ft = feet or foot
HRSA = Hackensack River Study Area
ORP = oxidation-reduction potential
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PCDD/PCDF = polychlorinated debenzodioxin/polychlorinated dibenzofuran
pH = potential of hydrogen
SVOC = semivolatile organic compound
TAL = target analyte list
TEPH = total extractable petroleum hydrocarbons
TOC = total organic compound
VOC = volatile organic compound

Table 4-1
Sediment Sampling Summary for Chemical Analyses in the Hackensack River Study Area

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Sample Type/ Location	Number of Sampling Locations	Number of Samples from Each Core/Location	Analytes	Number of Field Samples					
				Sediment Samples[a]	Field Duplicate[b]	Rinsate Blank[b]	MS/MSD[b]	Trip Blanks[c]	Total Samples[d]
4-ft Cores	9	3	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size	27	2	2	2	1	34
20-ft Core	1	4	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size	4	1	1	1	1	8
Oil-like Substance Delineation Cores[e]	8[e]	3[e]	PAHs, TEPH, TOC, grain size, pH	24[e]	2[e]	2[e]	2[e]	-	30[e]
Large Mudflats – Grab Samples	1	2	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size, AVS/SEM	2	-	-	-	-	2
Small Mudflats – Grab Samples	4	1	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size, AVS/SEM	4	1	1	1	1	8

Table 4-1
Sediment Sampling Summary for Chemical Analyses in the Hackensack River Study Area

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Sample Type/ Location	Number of Sampling Locations	Number of Samples from Each Core/Location	Analytes	Number of Field Samples					
				Sediment Samples[a]	Field Duplicate[b]	Rinsate Blank[b]	MS/MSD[b]	Trip Blanks[c]	Total Samples[d]
Subtidal Areas – Grab Samples	4	1	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size, AVS/SEM	4	1	1	1	1	8
			Total Number of Samples[c]	**65**	**7**	**7**	**7**	**4**	**90**

Notes:

a. Table represents maximum number of samples to be collected in the Hackensack River Study Area. The actual number of samples collected may be lower or higher.
b. Field duplicates, rinsate blanks, and matrix spike/matrix spike duplicate samples will be collected at a frequency of 1 per 20 samples.
c. Trip blanks are only associated with VOC samples.
d. Total number of samples includes quality assurance/quality control samples.
e. Number of delineation cores and sediment samples collected is dependent upon field observations of oil-like substances. A minimum of 8 cores and 3 sediment intervals are assumed, but the final number may be lower or higher.

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted metals
ORP = oxidation-reduction potential
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PCDD/PCDF = polychlorinated dibenzodioxin/polychlorinated dibenzofuran
pH = potential for hydrogen
SVOC = semivolatile organic compound
TAL = target analyte list
TEPH = total extractable petroleum hydrocarbons
TOC = total organic carbon
VOC = volatile organic compound

Table 4-2
Sampling Summary for the Reference Area

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Sample Type	Number of Sampling Locations	Number of Samples from Each Location/Core	Analysis	Number of Field Samples					
				Samples[a]	Field Duplicate[b]	Rinsate Blank[b]	MS/MSD[b]	Trip Blanks[c]	Total Samples[d]
Sediment Cores	2	3	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size	6	1	1	1	1	10
Surface Sediment – Mudflats	2	1	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size, AVS/SEM	2	1	1	1	1	6
Surface Sediment – Subtidal Area	1	1	PCB congeners and homologues, Aroclor PCBs, pesticides, TEPH, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, TOC, hexavalent chromium, PCDDs/PCDFs, pH, ORP, VOCs, percent moisture, grain size, AVS/SEM	1	-	-	-	1	2
Bulk Surface Sediment	3	3	Benthic Community Analysis	9	-	-	-	-	9
	3	1	28-day Sediment Bioassay – *Leptocheirus plumulosus*	3	1	-	-	-	4
Forage Fish (mummichog) Composites	2	1	PCB congeners and homologues, Aroclor PCBs, pesticides, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, PCDDs/PCDFs, total lipids	2	1	1	1	-	5

Table 4-2
Sampling Summary for the Reference Area

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Sample Type	Number of Sampling Locations	Number of Samples from Each Location/Core	Analysis	Number of Field Samples					
				Samples[a]	Field Duplicate[b]	Rinsate Blank[b]	MS/MSD[b]	Trip Blanks[c]	Total Samples[d]
Blue Crab Composites	2	1	PCB congeners and homologues, Aroclor PCBs, pesticides, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, PCDDs/PCDFs, total lipids	2	1	1	1	-	5
			Total Number of Samples[c]	**25**	**5**	**4**	**4**	**3**	**41**

Notes:

a. Table represents maximum number of samples to be collected in the reference area. The actual number of samples collected may be lower or higher.
b. Field duplicates, rinsate blanks, and matrix spike/matrix spike duplicate samples will be collected at a frequency of 1 per 20 samples.
c. Trip blanks are only associated with VOC samples.
d. Total number of samples includes quality assurance/quality control samples.

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted metals
ORP = oxidation-reduction potential
PCB = polychlorinated biphenyl
PCDD/PCDF = polychlorinated dibenzodioxin/ polychlorinated dibenzofuran
pH = potential of hydrogen
SVOC = semivolatile organic compound
TAL = target analyte list
TEPH = total extractable petroleum hydrocarbons
TOC = total organic carbon
VOC = volatile organic compound

Table 4-3
Sampling Summary for Ecological Analyses in the Hackensack River Study Area

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Ecological Component	Number of Sampling Locations	Number of Samples from Each Location	Analysis	Number of Field Samples					
				Samples[a]	Field Duplicate[b]	Rinsate Blank[b]	MS/MSD[b]	Trip Blanks[c]	Total Samples[d]
Bulk Surface Sediment									
Benthic Community Analysis	10	3	Taxa Identification Abundance/Diversity	30	-	-	-	-	30
Toxicity Testing	10	1	28-day Sediment Bioassay with *Leptocheirus plumulosus*	10	1	-	-	-	11
Biological Tissue									
Forage Fish (mummichog) Composites	6	1	PCB congeners and homologues, Aroclor PCBs, pesticides, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, PCDDs/PCDFs, total lipids	6	1	1	1	-	9
Blue Crab Composites	6	1	PCB congeners and homologues, Aroclor PCBs, pesticides, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, PCDDs/PCDFs, total lipids	6	1	1	1	-	9
Predatory Fish Tissue Samples	2	8	PCB congeners and homologues, Aroclor PCBs, pesticides, SVOCs, chlorinated herbicides, TAL metals (including mercury), cyanide, PCDDs/PCDFs, total lipids	16	1	1	1	-	19
			Total Number of Samples[d]	**68**	**4**	**3**	**3**	**-**	**78**

Notes:

a. Table represents maximum number of samples to be collected in the Hackensack River Study Area. The actual number of samples collected may be lower.
b. Field duplicates, rinsate blanks, and matrix spike/matrix spike duplicate samples will be collected at a frequency of 1 per 20 samples for analytical chemistry.
c. Trip blanks are only collected for VOC analysis which will not be performed on tissue samples.
d. Total number of samples includes quality control/quality assurance samples.

Table 4-3
Sampling Summary for Ecological Analyses in the Hackensack River Study Area

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Acronyms and Abbreviations:

MS/MSD = matrix spike/matrix spike duplicate
PCB = polychlorinated biphenyl
PCDD/PCDF = polychlorinated dibenzodioxin/polychlorinated dibenzofuran
SVOC = semivolatile organic compound
TAL = target analyte list

Table 4-4
Sampling Details for Sediment Core Samples

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Location	Core ID	New Jersey State Plane Coordinates (NAD 83)[a]		Number of Samples per Core[b]	Target Penetration (ft-bss)	Chemical Sample Intervals[c]							
		Easting (feet)	Northing (feet)			Segment 1 (ft-bss)	Segment 2 (ft-bss)	Segment 3 (ft-bss)	Segments 4 through 7 (ft-bss)	Segment 8 (ft-bss)	Segment 9 (ft-bss)	Segment 10 (ft-bss)	Segment 11 (ft-bss)
Cores													
RI Core 005 (Transect 5)	HRSRSED073	608181	695475	4	20	NA	NA	NA	NA	14-Dec	14 - 16	16 - 18	18 - 20
Transect 6[d]	HRSRSED072	608608	695685	2	4	NA	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 8	HRSRSED071	609398	696198	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 10	HRSRSED070	609730	697012	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 12	HRSRSED069	609353	697692	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 14[d]	HRSRSED068	608709	697747	2	4	NA	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 16	HRSRSED067	607919	697564	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 18	HRSRSED066	606926	697498	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 20[d]	HRSRSED065	605782	697668	2	4	NA	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transect 23 - Transect 24[d]	HRSRSED064	604161	698791	2	4	NA	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Reference Area	HRSRSED	TBD	TBD	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Reference Area	HRSRSED	TBD	TBD	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Oil-like Substance Delineation Cores[e]													
Transects 10-15	DC-A1	608247	697575	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-A2	608250	697678	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-A3	608253	697780	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-A4	608257	697883	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-AA1	609634	697011	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-AA3	609834	697015	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-AA4	609934	697016	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-C1	608399	697605	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-C2	608402	697709	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-C3	608406	697812	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-C4	608409	697915	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-E1	608539	697637	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-E2	608545	697737	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-E3	608550	697838	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-E4	608556	697938	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-G1	608698	697646	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-G3	608720	697848	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-G4	608730	697949	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-I1	608842	697657	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-I2	608856	697759	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-I3	608870	697861	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-I4	608884	697963	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-K1	608996	697672	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-K2	609014	697774	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A

Table 4-4
Sampling Details for Sediment Core Samples

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Location	Core ID	New Jersey State Plane Coordinates (NAD 83)[a]		Number of Samples per Core[b]	Target Penetration (ft-bss)	Chemical Sample Intervals[c]							
		Easting (feet)	Northing (feet)			Segment 1 (ft-bss)	Segment 2 (ft-bss)	Segment 3 (ft-bss)	Segments 4 through 7 (ft-bss)	Segment 8 (ft-bss)	Segment 9 (ft-bss)	Segment 10 (ft-bss)	Segment 11 (ft-bss)
Transects 10-15	DC-K3	609032	697877	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-K4	609049	697979	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-M1	609153	697687	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-M3	609192	697888	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-M4	609212	697989	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-O2	609372	697792	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-O3	609392	697893	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-O4	609413	697993	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-Q2	609437	697764	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-Q3	609521	697835	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-Q4	609604	697907	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-S1	609547	697604	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-S2	609634	697656	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-S3	609721	697709	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-S4	609807	697761	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-U1	609603	697462	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-U3	609799	697501	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-W1	609626	697307	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-W2	609726	697317	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-W3	609826	697327	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-W4	609925	697337	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-Y1	609628	697161	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-Y2	609728	697164	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-Y3	609828	697167	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A
Transects 10-15	DC-Y4	609928	697171	3	4	0 - 0.5	0.5 - 2	2 - 4	NA	N/A	N/A	N/A	N/A

Notes:

a. Actual locations may vary depending upon field conditions.
b. Does not include QA/QC samples.
c. Core samples will be analyzed for the analytical chemistry parameters shown in Table 4-1.
d. Proposed core locations are co-located with surface sediment grab samples therefore the top core segment does not require analysis.
e. Not all locations will be sampled. Locations, samples, and segments are estimates based on previous sediment chemistry and may change according to the presence or absence of oil-like substances found during the sampling event. The final core locations will be reported in the Supplemental RI Report.

Acronyms and Abbreviations:

ft-bss = feet below sediment surface
NA = not applicable
NAD 83 = North American Datum of 1983
TBD = to be determined; core locations in the reference area to be determined in the field

Table 4-5
Sampling Details for Sediment Grab Samples

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Location	Grab Sample ID	New Jersey State Plane Coordinates (NAD 83)[a]		Number of Samples per Analysis[b]			Target Penetration (ft-bss)
		Easting (feet)	Northing (feet)	Chemistry[c]	Toxicity Test	Benthic Community Analysis	
Mudflat Number							
3	HRSRSED058	608111	694673	1	1	3	0.5
5	HRSRSED059	608037	695485	1	1	3	0.5
7	HRSRSED060	608951	695969	1	1	3	0.5
10	HRSRSED061	607252	699093	1	1	3	0.5
10	HRSRSED062	605809	698645	1	1	3	0.5
12	HRSRSED063	604640	699275	1	1	3	0.5
Reference Area	HRSRSED	TBD	TBD	1	1	3	0.5
Reference Area	HRSRSED	TBD	TBD	1	1	3	0.5
Subtidal Area							
1	HRSRSED064	604161	698791	1	1	3	0.5
2	HRSRSED065	605782	697668	1	1	3	0.5
3	HRSRSED068	608709	697747	1	1	3	0.5
4	HRSRSED072	608608	695685	1	1	3	0.5
Reference Area	HRSRSED	TBD	TBD	1	1	3	0.5

Notes:

a. Actual locations may vary depending upon field conditions.
b. Does not include QA/QC samples.
c. Surface sediment grab samples will be analyzed for the analytical chemistry parameters shown in Table 4-1.

Acronyms and Abbreviations:

ft-bss = feet below sediment surface
NAD 83 = North American Datum of 1983
TBD = to be determined; sampling locations on the mudflats and subtidal areas in the reference area to be determined in the field

Table 4-6
Sampling Details for Biological Tissue Samples

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Location	Tissue Sample ID	New Jersey State Plane Coordinates (NAD 83)[a]		Number of Samples for Chemical Analysis[b]		
		Easting (feet)	Northing (feet)	Mummichog Composite	Blue Crab Composite	Predatory Fish Tissue[c]
Mudflats						
3	HRSRTIS058	608111	694673	1	1	NA
5	HRSRTIS059	608037	695485	1	1	NA
7	HRSRTIS060	608951	695969	1	1	NA
10	HRSRTIS061	607252	699093	1	1	NA
10	HRSRTIS062	605809	698645	1	1	NA
12	HRSRTIS063	604640	699275	1	1	NA
Reference Area	HRSRTIS	TBD	TBD	1	1	NA
Reference Area	HRSRTIS	TBD	TBD	1	1	NA
In-River Transects[d]						
Transect 7	HRSRTIS074	609123	695705	NA	NA	8
Transect 22	HRSRTIS075	604815	698250	NA	NA	8

Notes:

a. Actual locations may vary depending upon field conditions.

b. Tissue samples will be analyzed for the chemistry parameters shown in Table 4-3. Sample numbers do not include QA/QC samples.

c. Predatory fish consist of upper-trophic level fish such as striped bass, white perch, etc.

d. Upper-trophic predatory fish will be captured along two in-River transects using gill nets. Locations are approximate.

Acronyms and Abbreviations:

NA = not applicable

NAD 83 = North American Datum of 1983

TBD = to be determined; sampling locations on the mudflats and subtidal areas in the reference area to be determined in the field

Table 4-7
Analytical Hierarchical Prioritization[a] and Sample Weight Requirements

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Number	Analyses	Sediment Method Requires (g)[a]	Sediment					Tissue				
			Desired Minimum Sample Weight Wet (g)	Cumulative Weight Wet (g)	Sample Weight for QC Samples[c]			Desired Minimum Sample Weight Wet (g)	Cumulative Weight Wet (g)	Sample Weight for QC Samples[c]		
					MS Weight Wet (g)	MSD Weight Wet (g)	Duplicate Weight Wet (g)			MS Weight Wet (g)	MSD Weight Wet (g)	Duplicate Weight Wet (g)
---	Volatile Organics/Percent Moisture[b]	5 - wet	15/5	20	15	15	NA	NA	NA	NA	NA	NA
1	PCDDs/PCDFs	10 - dry	75	95	75	75	NA	10	10	10	10	10
2	PCB Congeners and Homologues	10 - dry	75	170	75	75	NA	12	22	12	12	12
3	Pesticides and Aroclor PCBs	30 - wet	60	230	60	60	NA	12	34	12	12	12
4	Semivolatile Organics	30 - wet	60	290	60	60	NA	5	39	5	5	5
5	Mercury	1 - wet	5	295	5	NA	5	1	40	1	1	1
6	Hexavalent Chromium	2.5 - wet	20	315	20	20	20	NA	NA	NA	NA	NA
7	Target Analyte List Metals	1- wet	10	325	10	10	10	1	41	1	1	1
8	AVS/SEM[b]	10 - wet	10	335	10	10	10	NA	NA	NA	NA	NA
9	pH	25 - wet	50	385	NA	NA	NA	NA	NA	NA	NA	NA
10	ORP	100 - wet	200	585	NA	NA	NA	NA	NA	NA	NA	NA
11	Herbicides	30 - wet	60	645	60	60	NA	15	56	15	15	15
12	Cyanide	2 - wet	10	655	10	NA	10	2	58	2	2	2
13	TEPH	30 - wet	60	715	60	60	NA	NA	NA	NA	NA	NA
14	Total Organic Carbon	1 - wet	20	735	20	20	NA	NA	NA	NA	NA	NA
15	Grain Size	500 - wet	500	1235	NA	NA	NA	NA	NA	NA	NA	NA
16	Percent Moisture	10 - wet	20	1255	NA	NA	NA	NA	NA	NA	NA	NA
17	Total Lipids	10 - wet	NA	NA	NA	NA	NA	10	68	NA	NA	10
	Total		1255	1255	480	465	55	68	68	58	58	68

Notes:

a. For a given sample, if insufficient mass is obtained to complete all of the listed analyses, then collect volatile organics/percent moisture and proceed to collect samples in sequence in this table, beginning with Item Number 1.
b. Samples for volatile organic analysis and AVS/SEM must be collected prior to homogenization.
c. QC sample weights are in addition to desired minimums listed. QC samples do not need to be obtained from the same field sample for all analytical groups.

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted
g = gram
MS = matrix spike
MSD = matrix spike duplicate
NA = not applicable
ORP = oxidation-reduction potential
PCB = polychlorinaed biphenyl
PCDD/PCDF = polychorindaed dibenzodioxin/polychlorinated dibenzofuran
pH = potential of hydrogen
QC = quality control
TEPH = total extractable petroleum hydrocarbons

Table 4-8
Sample Bottle and Preservation Specifications for Analysis of Sediment and Tissue Samples[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Parameters Analyzed[a]	Sediment				Tissue			
	Holding Time[b]	Recommended Size Sample Container[c,d]	Container Material	Preservative	Holding Time[b]	Recommended Size Sample Container	Container Material	Preservative
VOCs	48 hours to extraction, 14 days until analysis	(3X) 5g EnCore™ Sampler	EnCore™ Sampler	4°C	NA	NA	NA	NA
TAL Metals	6 months	16 oz	G[e]	4°C	6 months	Ziploc bags (pre-homogenization)	Ziploc bags (pre-homogenization)	Frozen
Mercury	28 days				28 days			Frozen
Cyanide	14 days				14 days			Frozen
SVOCs	14 days to extract, 40 days to analyze				1 year to extract, 40 days until analysis			Frozen
Aroclors, PCBs/ Pesticides	14 days to extract, 40 days to analyze				1 year to extract, 40 days until analysis			Frozen
Chlorinated Herbicides	14 days to extract, 40 days to analyze				1 year to extract, 40 days until analysis			Frozen
Hexavalent Chromium	28 days				NA	NA	NA	NA
TOC	14 days				NA	NA	NA	NA
pH	as soon as possible				NA	NA	NA	NA
ORP	as soon as possible				NA	NA	NA	NA
AVS/SEM	14 days/28 days for SEM from extraction	4 oz	G[e]	4°C (min or no headspace)	NA	NA	NA	NA
TEPH	14 days to extract, 40 days to analyze	4 oz	G[e]	4°C	NA	NA	NA	NA
Grain Size	28 days	32 oz	G[e]	4°C	NA	NA	NA	NA
PCB Congeners and Homologues	14 days to extraction, 40 days until analysis	16 oz	G[e]	4°C	1 year to extract, 40 days until analysis	Ziploc bags (pre-homogenization)	Ziploc bags (pre-homogenization)	Frozen
PCDDs/PCDFs	30 days to extraction, 40 days until analysis				1 year to extract, 40 days until analysis			
Percent Lipids	NA	NA	NA	NA	1 year	Ziploc bags (pre-homogenization)	Ziploc bags (pre-homogenization)	Frozen
Sediment Toxicity	14 days	2½ gallon	Plastic pails (or equivalent containers)	NA	NA	NA	NA	NA
Benthic Community Analysis	NA	1 liter	Plastic widemouth jars	10% solution of buffered formalin or equivalent	NA	NA	NA	NA

Notes:

a. Analytical methods are specified in Table 6-12

b. Holding time is calculated from the date of sample collection to the date of sample analysis (or extraction as noted).

c. Samples for analyses having identical container and preservation requirements may be combined in the same container. The noted 16-oz. container will hold sufficient mass to meet the minimum requirements specified in Table 6-6 for all specified analyses.

d. Wide-mouth jars with Teflon-lined lids preferred

e. Amber glass

Table 4-8
Sample Bottle and Preservation Specifications for Analysis of Sediment and Tissue Samples[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted metals
NA = not applicable
oz = ounce
PCB = polychlorinated biphenyl
PCDD/PCDF = polychorindaed dibenzodioxin/polychlorinated dibenzofuran
SVOC = semivolatile organic compound
TAL = target analyte list
TEPH = total extractable petroleum hydrocarbons
VOC = volatile organic compound

Table 4-9
Sample Bottle, Volume, and Preservation Specifications for Analysis of Rinsate Blanks[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Parameters[a] Analyzed	Holding Time[b]	Approximate Volume[c]	Container Material	Preservative
TAL Metals	6 months	500 ml	Plastic	HNO_3 to pH<2, 4°C
Mercury	28 days			HNO_3 to pH<2, 4°C
Hexavalent Chromium	28 days	250 ml	Plastic	4°C
Cyanide	14 days	500 ml	Plastic	NaOH to pH>12, 4°C
PCDDs/PCDFs	30 days to extract, 40 days to analyze	1 liter	Amber glass	4°C
Semivolatile Organics	7 days to extract, 40 days to analyze	1 liter	Amber glass	4°C
Volatile Organics	14 days	3 x 40ml	Glass, Teflon-lined septa	4°C; HCl to pH<2
Aroclor PCBs	7 days to extract, 40 days to analyze	1 liter	Amber glass	4°C
PCB Congeners and Homologues	7 days, 40 days to analyze	1 liter	Amber glass	4°C
Chlorinated Herbicides	7 days to extract, 40 days to analyze	1 liter	Amber glass	4°C
TOC	28 days	3 x 40ml	Glass, Teflon-lined septa	4°C; H_2SO_4 to pH<2
TEPH	14 days to extract, 40 days to analyze	1 liter	Amber glass	4°C; HCl to pH<2
Pesticides	7 days to extract, 40 days to analyze	1 liter	Amber glass	4°C
AVS/SEM	14 days	500 ml	Amber glass	NaOH to pH>12, 4°C
pH	As soon as possible	250 ml	Plastic	2 to 4°C
ORP	As soon as possible			2 to 4°C

Notes:

a. Analytical methods are specified in Table 6-12.
b. Holding time is calculated from the date and time of sample collection to the date and time of sample extraction or analysis.

c. For each sample sent to a laboratory for extractable analysis (i.e., TEPH, semivolatile organics, PCB congeners and homologues, pesticides, Aroclor PCBs, and herbicides), an extra 1-liter bottle should be provided, if practical, in case of breakage or spillage from one of the sample bottles.

Acronyms and Abbreviations:

°C = degrees Celsius
ml = milliliters
ORP = oxidation-reduction potential
PCB = polychlorinated biphenyl
PCDD/PCDF = polychorinated dibenzodioxin/polychlorinated dibenzofuran
pH = potential of hydrogen
TAL = target analyte list
TEPH = total extractable petroleum hydrocarbons
TOC = total organic compound

Table 6-1
Method 8270C (GC/MS) Sample Quantitation Limits and Method Detection Limits for Semivolatile Organics[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

	Water		Sediment		Tissue	
Compounds	SQL (µg/L)	MDL (µg/L)	SQL (µg/kg)	MDL (µg/kg	SQL (mg/kg)	MDL (mg/kg)
Phenol	2	0.24	67	13	0.067	0.020
bis (2-Chloroethyl) ether	2	0.26	67	5.9	0.067	0.007
2-Chlorophenol	10	0.21	330	10	0.33	0.017
1,3-Dichlorobenzene	2	0.28	67	11	0.067	0.012
1,4-Dichlorobenzene	2	0.34	67	17	0.067	0.013
1,2-Dichlorobenzene	2	0.29	67	12	0.067	0.019
2-Methylphenol	10	0.14	330	12	0.33	0.021
2,2'-oxybis(1-chloropropane)	2	0.35	67	15	0.067	0.020
3 & 4-Methylphenol	10	0.18	330	15	0.33	0.021
N-Nitrosodi-n-propylamine	2	0.39	67	19	0.067	0.008
Hexachloroethane	10	0.08	330	11	0.33	0.015
Nitrobenzene	2	0.18	67	17	0.067	0.008
Isophorone	10	0.29	330	13	0.33	0.018
2-Nitrophenol	10	0.14	330	13	0.33	0.026
2,4-Dimethylphenol	10	0.08	330	14	0.33	0.014
bis (2-Chloroethoxy) methane	10	0.14	330	13	0.33	0.015
2,4-Dichlorophenol	2	0.13	67	14	0.067	0.010
1,2,4-Trichlorobenzene	2	0.46	67	8.4	0.067	0.016
Naphthalene	2	0.28	67	9.7	0.067	0.016
4-Chloroaniline	10	1.09	330	10	0.33	0.029
Hexachlorobutadiene	2	0.12	67	14	0.067	0.020
4-Chloro-3-methylphenol	10	0.25	330	10	0.33	0.020
Hexachlorocyclopentadiene	10	0.12	330	13	0.33	0.015
2-Methylnaphthalene	2	0.16	67	13	0.067	0.018
2,4,6-Trichlorophenol	10	0.09	330	17	0.33	0.027
2,4,5-Trichlorophenol	10	0.15	330	8.2	0.33	0.027
2-Chloronaphthalene	2	0.15	67	9.0	0.067	0.019
2-Nitroaniline	50	0.17	1700	20	1.7	0.020
Dimethylphthalate	10	0.14	330	11	0.33	0.019
Acenaphthylene	2	0.085	67	13	0.067	0.019
2,6-Dinitrotoluene	10	0.19	330	17	0.33	0.021
3-Nitroaniline	50	0.26	1700	11	1.7	0.028
acenaphthene	2	0.14	67	11	0.067	0.017
2,4-Dinitrophenol	50	6.1	1700	107	1.7	0.39
4-Nitrophenol	50	3.9	1700	197	1.7	0.026
Dibenzofuran	10	0.18	330	11	0.33	0.018
2,4-Dinitrotoluene	10	0.17	330	16	0.33	0.017
Diethylphthalate	10	0.45	330	19	0.33	0.030
4-Chlorophenyl phenyl ether	10	0.10	330	15	0.33	0.016
Fluorene	2	0.10	67	10	0.067	0.016
4-Nitroaniline	50	0.23	1700	16	1.7	0.014
4,6-Dinitro-2-methylphenol	50	7.8	1700	321	1.7	0.23
N-nitrosodiphenylamine	2	0.14	67	14	0.067	0.018
4-Bromophenyl-phenyl ether	10	0.19	330	14	0.33	0.015
Hexachlorobenzene	2	0.18	67	13	0.067	0.020
Pentachlorophenol	10	1.9	330	58	0.33	0.025
Phenanthrene	2	0.28	67	8.0	0.067	0.016
Anthracene	2	1.0	67	12	0.067	0.019
Carbazole	2	0.14	67	9	0.067	0.014
Di-n-butylphthalate	10	0.30	330	19	0.33	0.055
Fluoranthene	2	0.10	67	5.6	0.067	0.021

Table 6-1
Method 8270C (GC/MS) Sample Quantitation Limits and Method Detection Limits for Semivolatile Organics[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water		Sediment		Tissue	
	SQL (µg/L)	MDL (µg/L)	SQL (µg/kg)	MDL (µg/kg	SQL (mg/kg)	MDL (mg/kg)
Pyrene	2	0.11	67	18	0.067	0.020
Butylbenzylphthalate	10	3.1	330	23	0.33	0.027
3,3'-Dichlorobenzidine	10	0.36	330	63	0.33	0.075
Benzo(a)anthracene	2	0.18	67	11	0.067	0.013
Chrysene	2	0.11	67	12	0.067	0.013
bis (2-Ethylhexyl) phthalate	10	0.46	330	28	0.33	0.025
Di-n-octylphthalate	10	0.16	330	8.6	0.33	0.023
Benzo(b)fluoranthene	2	0.16	67	14	0.067	0.013
Benzo(k)fluoranthene	2	0.16	67	14	0.067	0.011
Benzo(a)pyrene	2	0.12	67	19	0.067	0.010
Indeno (1,2,3-cd) pyrene	2	0.16	67	3.7	0.067	0.012
Dibenz(a,h)anthracene	2	0.13	67	15	0.067	0.021
Benzo(g,h,i)perylene	2	0.14	67	4.9	0.067	0.011

Note:

a. SQLs are highly matrix-dependent. The laboratory-demonstrated MDL must be equal to or lower than the SQLs listed in this table. Limits for sediment are based on wet weight.

Acronyms and Abbreviations:

GC/MS = Gas Chromatography/Mass Spectrometry
MDL = method detection limit
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = miligrams per kilogram
SQL = sample quantitation limit

Table 6-2
Method 8081A Sample Quantitation Limits and Method Detection Limits for Pesticides[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water		Sediment[b]		Tissue	
	SQL (µg/L)	MDL (µg/L)	SQL (µg/kg)	MDL (µg/kg)	SQL (mg/kg)	MDL (mg/kg)
Aldrin	0.05	0.011	1.7	0.18	0.0017	0.00018
BHC-alpha	0.05	0.015	1.7	0.25	0.0017	0.00025
BHC-beta	0.05	0.014	1.7	0.20	0.0017	0.00020
BHC-delta	0.05	0.009	1.7	0.18	0.0017	0.00018
BHC-gamma (Lindane)	0.05	0.015	1.7	0.23	0.0017	0.00023
Chlordane-	0.05	0.008	1.7	0.17	0.0017	0.00017
Chlordane-alpha	0.05	0.011	1.7	0.10	0.0017	0.00010
Dieldrin	0.05	0.008	1.7	0.12	0.0017	0.00012
4,4'-DDD	0.05	0.008	1.7	0.15	0.0017	0.00015
4,4'-DDE	0.05	0.007	1.7	0.10	0.0017	0.00010
4,4'-DDT	0.05	0.014	1.7	0.23	0.0017	0.00023
Endosulfan-1	0.05	0.007	1.7	0.17	0.0017	0.00017
Endosulfan-2	0.05	0.015	1.7	0.38	0.0017	0.00038
Endosulfan sulfate	0.05	0.016	1.7	0.27	0.0017	0.00027
Endrin	0.05	0.008	1.7	0.13	0.0017	0.00013
Endrin aldehyde	0.05	0.012	1.7	0.21	0.0017	0.00021
Endrin ketone	0.05	0.010	1.7	0.19	0.0017	0.00019
Heptachlor	0.05	0.014	1.7	0.21	0.0017	0.00021
Heptachlor	0.05	0.010	1.7	0.17	0.0017	0.00017
Methoxychlor	0.1	0.018	3.3	0.69	0.0033	0.00069
Toxaphene	2	0.411	67	12	0.067	0.012

Notes:

a. SQLs are highly matrix-dependent. The laboratory-derived MDL must be at least a factor of three less than the SQLs provided in this table, with the exception of chlordane-gamma in the water matrix.
b. SQLs listed for sediment are based on wet weight. Limits for sediment are calculated on a dry weight basis and will be higher.
c. The laboratory-derived MDL for chlordane-gamma in water must be at least a factor of two less than the SQL provided in this table.

Acronyms and Abbreviations:

MDL = method detection limit
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = miligrams per kilogram
SQL = sample quantitation limit

Table 6-3
Method 8082 Sample Quantitation Limits and Method Detection Limits for Aroclor PCBs[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water		Sediment[b]		Tissue	
	SQL (µg/L)	MDL (µg/L)	SQL (µg/kg)	MDL (µg/kg)	SQL (mg/kg)	MDL (mg/kg)
Aroclor-1016	0.4	0.10	16.667	2.5	0.033	0.0077
Aroclor-1221	0.4	0.10	16.667	3.2	0.033	0.028
Aroclor-1232	0.4	0.12	16.667	2.9	0.033	0.020
Aroclor-1242	0.4	0.074	16.667	2.7	0.033	0.014
Aroclor-1248	0.4	0.091	16.667	1.6	0.033	0.017
Aroclor-1254	0.4	0.092	16.667	2.4	0.033	0.016
Aroclor-1260	0.4	0.054	16.667	2.4	0.033	0.0090
Aroclor-1262	0.4	0.082	16.667	3.7	TBD	TBD
Aroclor-1268	0.4	0.11	16.667	2.1	0.033	0.016

Notes:

a. SQLs are highly matrix-dependent. The laboratory-derived MDL must be at least a factor of three less than the SQLs provided in this table.

b. Limits for sediment are based on wet weight. SQLs reported by the laboratory for sediment are calculated on a dry weight basis and will be higher.

Acronyms and Abbreviations:

MDL = method detection limit
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = miligrams per kilogram
PCB = polychlorinated biphenyl
SQL = sample quantitation limit
TBD = to be determined

Table 6-4
Method 1668 Rev. A Sample Quantitation Limits for PCB Congeners[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water SQL (pg/L)	Sediment SQL (pg/g)	Tissue SQL (pg/g)
PCB1	25	2.5	2.5
PCB2	25	2.5	2.5
PCB3	25	2.5	2.5
PCB4/10	50	5	5
PCB6	50	5	5
PCB5/8	50	5	5
PCB7/9	50	5	5
PCB11	50	5	5
PCB12/13	50	5	5
PCB14	50	5	5
PCB15	50	5	5
PCB16/32	50	5	5
PCB17	25	2.5	2.5
PCB18	25	2.5	2.5
PCB19	25	2.5	2.5
PCB20/21/33	25	2.5	2.5
PCB22	25	2.5	2.5
PCB23	25	2.5	2.5
PCB24/27	25	2.5	2.5
PCB25	25	2.5	2.5
PCB26	25	2.5	2.5
PCB28	25	2.5	2.5
PCB29	25	2.5	2.5
PCB30	25	2.5	2.5
PCB31	25	2.5	2.5
PCB34	25	2.5	2.5
PCB35	25	2.5	2.5
PCB36	25	2.5	2.5
PCB37	25	2.5	2.5
PCB38	25	2.5	2.5
PCB39	25	2.5	2.5
PCB40	25	2.5	2.5
PCB41/64/71/72	25	2.5	2.5
PCB42/59	25	2.5	2.5
PCB43/49	25	2.5	2.5
PCB44	25	2.5	2.5
PCB45	25	2.5	2.5
PCB46	25	2.5	2.5
PCB47	25	2.5	2.5
PCB48/75	25	2.5	2.5
PCB50	25	2.5	2.5
PCB51	25	2.5	2.5
PCB52/69	25	2.5	2.5
PCB53	25	2.5	2.5
PCB54	25	2.5	2.5
PCB55	25	2.5	2.5

Table 6-4
Method 1668 Rev. A Sample Quantitation Limits for PCB Congeners[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water SQL (pg/L)	Sediment SQL (pg/g)	Tissue SQL (pg/g)
PCB56/60	25	2.5	2.5
PCB57	25	2.5	2.5
PCB58	25	2.5	2.5
PCB61	25	2.5	2.5
PCB62	25	2.5	2.5
PCB63	25	2.5	2.5
PCB65	25	2.5	2.5
PCB66	25	2.5	2.5
PCB67	25	2.5	2.5
PCB68	25	2.5	2.5
PCB70	25	2.5	2.5
PCB73	25	2.5	2.5
PCB74	25	2.5	2.5
PCB76	25	2.5	2.5
PCB77	25	2.5	2.5
PCB78	25	2.5	2.5
PCB79	25	2.5	2.5
PCB80	25	2.5	2.5
PCB81	25	2.5	2.5
PCB82	25	2.5	2.5
PCB83	25	2.5	2.5
PCB84/92	25	2.5	2.5
PCB85/116	25	2.5	2.5
PCB86	25	2.5	2.5
PCB87/117/125	25	2.5	2.5
PCB88/91	25	2.5	2.5
PCB89	25	2.5	2.5
PCB90/101	25	2.5	2.5
PCB93	25	2.5	2.5
PCB94	25	2.5	2.5
PCB95/98/102	25	2.5	2.5
PCB96	25	2.5	2.5
PCB97	25	2.5	2.5
PCB99	25	2.5	2.5
PCB100	25	2.5	2.5
PCB103	25	2.5	2.5
PCB104	25	2.5	2.5
PCB105	25	2.5	2.5
PCB106/118	25	2.5	2.5
PCB107/109	25	2.5	2.5
PCB108/112	25	2.5	2.5
PCB110	25	2.5	2.5
PCB111/115	25	2.5	2.5
PCB113	25	2.5	2.5
PCB114	25	2.5	2.5
PCB119	25	2.5	2.5

Table 6-4
Method 1668 Rev. A Sample Quantitation Limits for PCB Congeners[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water SQL (pg/L)	Sediment SQL (pg/g)	Tissue SQL (pg/g)
PCB120	25	2.5	2.5
PCB121	25	2.5	2.5
PCB122	25	2.5	2.5
PCB123	25	2.5	2.5
PCB124	25	2.5	2.5
PCB126	25	2.5	2.5
PCB127	25	2.5	2.5
PCB128/162	25	2.5	2.5
PCB129	25	2.5	2.5
PCB130	25	2.5	2.5
PCB131	25	2.5	2.5
PCB132/161	25	2.5	2.5
PCB133/143	25	2.5	2.5
PCB134/142	25	2.5	2.5
PCB135	25	2.5	2.5
PCB136	25	2.5	2.5
PCB137	25	2.5	2.5
PCB138/163/164	25	2.5	2.5
PCB139/149	25	2.5	2.5
PCB140	25	2.5	2.5
PCB141	25	2.5	2.5
PCB144	25	2.5	2.5
PCB145	25	2.5	2.5
PCB146/165	25	2.5	2.5
PCB147	25	2.5	2.5
PCB148	25	2.5	2.5
PCB150	25	2.5	2.5
PCB151	25	2.5	2.5
PCB152	25	2.5	2.5
PCB153	25	2.5	2.5
PCB154	25	2.5	2.5
PCB155	25	2.5	2.5
PCB156	25	2.5	2.5
PCB157	25	2.5	2.5
PCB158/160	25	2.5	2.5
PCB159	25	2.5	2.5
PCB166	25	2.5	2.5
PCB167	25	2.5	2.5
PCB168	25	2.5	2.5
PCB169	25	2.5	2.5
PCB170	25	2.5	2.5
PCB171	25	2.5	2.5
PCB172	25	2.5	2.5
PCB173	25	2.5	2.5
PCB174	25	2.5	2.5
PCB175	25	2.5	2.5

Table 6-4
Method 1668 Rev. A Sample Quantitation Limits for PCB Congeners[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water SQL (pg/L)	Sediment SQL (pg/g)	Tissue SQL (pg/g)
PCB176	25	2.5	2.5
PCB177	25	2.5	2.5
PCB178	25	2.5	2.5
PCB179	25	2.5	2.5
PCB180	25	2.5	2.5
PCB181	25	2.5	2.5
PCB182/187	25	2.5	2.5
PCB183	25	2.5	2.5
PCB184	25	2.5	2.5
PCB185	25	2.5	2.5
PCB186	25	2.5	2.5
PCB188	25	2.5	2.5
PCB189	25	2.5	2.5
PCB190	25	2.5	2.5
PCB191	25	2.5	2.5
PCB192	25	2.5	2.5
PCB193	25	2.5	2.5
PCB194	25	2.5	2.5
PCB195	25	2.5	2.5
PCB196/203	25	2.5	2.5
PCB197	25	2.5	2.5
PCB198	25	2.5	2.5
PCB199	25	2.5	2.5
PCB200	25	2.5	2.5
PCB201	25	2.5	2.5
PCB202	25	2.5	2.5
PCB204	25	2.5	2.5
PCB205	25	2.5	2.5
PCB206	25	2.5	2.5
PCB207	25	2.5	2.5
PCB208	25	2.5	2.5
PCB209	25	2.5	2.5

Note:

a. SQLs listed are based upon 1 liter of aqueous sample, 10 grams dry weight solid and tissue. SQLs may vary and are based upon the single PCB congener used to calibrate for the homologue series.

Acronyms and Abbreviations:

pg/L = picograms per liter
pg/g = picograms per gram
PCB = polychlorinated biphenyl
SQL = sample quantitation limit

Table 6-5

Method 1668 Rev. A Sample Quantitation Limits for PCB Homologues

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water SQL (pg/L)	Sediment SQL (pg/g)	Tissue SQL (pg/g)
Monochlorobiphenyl	25	2.5	2.5
Dichlorobiphenyl	50	5	5
Trichlorobiphenyl	25	2.5	2.5
Tetrachlorobiphenyl	25	2.5	2.5
Pentachlorobiphenyl	25	2.5	2.5
Hexachlorobiphenyl	25	2.5	2.5
Heptachlorobiphenyl	25	2.5	2.5
Octachlorobiphenyl	25	2.5	2.5
Nonachlorobiphenyl	25	2.5	2.5
Decachlorobiphenyl	25	2.5	2.5

Note:

a. SQLs are based upon 1 liter of aqueous sample, 10 grams dry weight solid and tissue. SQLs may vary and are based upon the single PCB congener used to calibrate for the homologue series.

Acronyms and Abbreviations:

pg/L = picograms per liter
pg/kg = picograms per gram
PCB = polychlorinated biphenyl
SQL = sample quantitation limit

Table 6-6

Method 8151A Sample Quantitation Limits and Method Detection Limits for Chlorinated Herbicides[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water		Sediment[b]		Tissue	
	SQL (µg/L)	MDL (µg/L)	SQL (µg/kg)	MDL (µg/kg)	SQL (mg/kg)	MDL (mg/kg)
2,4-D	4	0.52	80	20	0.08	0.020
2,4-DB	4	0.53	80	18	0.08	0.018
2,4,5-TP (Silvex)	1	0.13	20	2.5	0.02	0.0025
2,4,5-T	1	0.13	20	3.2	0.02	0.0032

Notes:

a. SQLs are highly matrix-dependent. The laboratory-demonstrated MDL must be equal to or lower than the SQLs listed in this table.
b. Limits for sediment are based on wet weight.

Acronyms and Abbreviations:

MDL = method detection limit
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = miligrams per kilogram
SQL = sample quantitation limit

Table 6-7

Method 1613B Sample Quantitation Limits for PCDD/PCDFs[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water	Sediment	Tissue
	SQL (pg/L)	SQL (pg/g)	SQL (pg/g)
2,3,7,8-TCDD	5	0.5	0.2
1,2,3,7,8-PeCDD	25	2.5	1
1,2,3,4,7,8-HxCDD	25	2.5	1
1,2,3,6,7,8-HxCDD	25	2.5	1
1,2,3,7,8,9-HxCDD	25	2.5	1
1,2,3,4,6,7,8-HpCDD	25	2.5	1
OCDD	50	5	2
2,3,7,8-TCDF	5	0.5	0.2
1,2,3,7,8-PeCDF	25	2.5	1
2,3,4,7,8-PeCDF	25	2.5	1
1,2,3,4,7,8-HxCDF	25	2.5	1
1,2,3,6,7,8-HxCDF	25	2.5	1
2,3,4,6,7,8-HxCDF	25	2.5	1
1,2,3,7,8,9-HxCDF	25	2.5	1
1,2,3,4,6,7,8-HpCDF	25	2.5	1
1,2,3,4,7,8,9-HpCDF	25	2.5	1
OCDF	50	5	2
Total TCDD	5	0.5	0.5
Total PeCDD	25	2.5	2.5
Total HxCDD	25	2.5	2.5
Total HpCDD	25	2.5	2.5
Total TCDF	5	0.5	0.5
Total PeCDF	25	2.5	2.5
Total HxCDF	25	2.5	2.5
Total HpCDF	25	2.5	2.5

Note:

a. SQLs are based upon 1 liter of aqueous sample, 10 grams dry weight soil and 25 grams of tissue.

Acronyms and Abbreviations:

pg/L = picograms per liter
pg/g = picograms per gram
PCDD = polychlorinated dibenzodioxin
PCDF = polychlorinated dibenzofuran
SQL = sample quantitation limit

Table 6-8
Sample Quantitation Limits and Method Detection Limits for TAL Metals (including Mercury) and Cyanide[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Analyte	Water		Sediment[b]		Tissue	
	SQL (µg/L)	MDL (µg/L)	SQL (mg/kg)	MDL (mg/kg)	SQL (mg/kg)	MDL (mg/kg)
Aluminum, Al	200	16	20	2.4	20	2.4
Antimony, Sb	10	1.8	1	0.21	1	0.21
Arsenic, As	10	2.0	1	0.29	1	0.29
Barium, Ba	200	0.26	20	0.079	20	0.079
Beryllium, Be	4	0.18	0.4	0.015	0.4	0.015
Cadmium, Cd	5	0.21	0.5	0.021	0.5	0.021
Calcium, Ca	5,000	18	500	1.7	500	1.7
Chromium, Cr	5	1.1	0.5	0.056	0.5	0.056
Cobalt, Co	50	0.45	5	0.081	5	0.081
Copper, Cu	25	4.6	2.5	0.26	2.5	0.26
Total Cyanide (SW846 9012A)	10	1.7	0.5	0.096	0.5	0.096
Iron, Fe	100	8.4	10	1.3	10	1.3
Lead, Pb	3	1.7	0.3	0.16	0.3	0.16
Magnesium, Mg	5,000	22	500	2.1	500	2.1
Manganese, Mn	15	0.57	1.5	0.061	1.5	0.061
Mercury, Hg	0.2	0.016	0.033	0.0025	0.033	0.0025
Nickel, Ni	40	0.78	4	0.14	4	0.14
Potassium, K	5,000	750	500	75	500	75
Selenium, Se	5	2.9	0.5	0.17	0.5	0.17
Silver, Ag	5	0.54	0.5	0.066	0.5	0.066
Sodium, Na	5,000	145	500	14.5	500	14.5
Thallium, Tl	10	2.8	1	0.31	1	0.31
Vanadium, V	50	2.4	5	0.24	5	0.24
Zinc, Zn	20	3.1	2	0.19	2	0.19

Notes:

a. Mercury will be analyzed as per Method SW-846 7471A, TAL metals by SW-846 6010B and cyanide by Method 9012A. SQLs are highly matrix-dependent. The laboratory MDL must be less than or equal to the SQL.

b. Limits for sediment are based on wet weight.

Acronyms and Abbreviations:

MDL = method detection limit
µg/L = micrograms per liter
mg/kg = miligrams per kilogram
SQL = sample quantitation limit
TAL = target analyte list

Table 6-9
Method 8270C (GC/MS) Sample Quantitation Limits and Method Detection Limits for Volatile Organics[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Compounds	Water		Sediment[b]	
	SQL (µg/L)	MDL (µg/L)	SQL (µg/kg)	MDL (µg/kg)
Chloromethane	5	1.4	5	0.85
Bromomethane	5	1.6	5	0.74
Vinyl Chloride	5	1.3	5	0.47
Chloroethane	5	0.75	5	1.55
Methylene Chloride	5	1.1	5	0.67
Acetone	20	5.0	20	5.0
Carbon Disulfide	5	1.1	5	0.51
1,1-Dichloroethene	5	1.1	5	0.85
1,1 –Dichloroethane	5	1.0	5	0.58
1,2 –Dichloroethene (total)	10	0.95	10	1.3
Chloroform	5	1.0	5	0.58
1,2-Dichloroethane	5	0.96	5	0.61
2-Butanone	5	1.1	5	0.88
1,1,1-Trichloroethane	5	1.0	5	0.49
Carbon Tetrachloride	5	1.1	5	0.45
Bromodichloromethane	5	0.93	5	0.56
1,2-Dichloropropane	5	1.3	5	0.54
Cis-1,3-Dichloropropene	5	0.73	5	0.68
Trichloroethene	5	0.80	5	0.66
Dibromochloromethane	5	0.65	5	0.71
1,1,2-Trichlorethane	5	1.2	5	0.83
Benzene	5	0.99	5	0.68
Trans-1,3-Dichloropropene	5	0.58	5	0.60
Bromoform	5	1.1	5	0.44
4-methyl-2-pentanone	5	0.59	5	0.65
2-hexanone	5	0.57	5	0.69
Tetrachloroethene	5	0.82	5	0.68
Toluene	5	0.85	5	0.73
1,1,2,2-Tetrachloroethane	5	0.93	5	0.72
Chlorobenzene	5	0.53	5	0.76
Ethyl Benzene	5	0.62	5	0.64
Styrene	5	0.64	5	0.71
Xylenes (total)	15	2.0	15	2.2

Notes:

a. SQLs are highly matrix-dependent. The laboratory-demonstrated MDL must be equal to or lower than the SQLs listed in this table.

b. Limits for sediment are based on wet weight.

Acronyms and Abbreviations:

GC/MS = Gas Chromatography/Mass Spectrometry
MDL = method detection limit
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
SQL = sample quantitation limit

Table 6-10
Sample Quantitation Limits and Method Detection Limits for AVS/SEM in Sediment

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Analyte	SQL (µmoles/g)	MDL (µmoles/g)
AVS/SEM	0.499	0.16
Cadmium, Cd	0.001112	0.000036
Copper, Cu	0.009835	0.00088
Lead, Pb	0.0007239	0.00024
Mercury, Hg	0.00006232	0.0000065
Nickel, Ni	0.01704	0.00049
Silver, Ag	0.00115	0.00013
Zinc, Zn	0.03823	0.0028

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted metals
MDL = method detection limit
µmoles/g = micromoles per gram
SQL = sample quantitation limit

Table 6-11
Sample Quantitation Limits and Method Detection Limits for Additional Parameters

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Analyte	Method	Water		Sediment		Tissue	
		SQL	MDL	SQL	MDL	SQL	MDL
TOC	SM 5310B (Water) Lloyd Kahn (Sediment)	1 mg/L	0.1401mg/L	500 mg/kg	115 mg/kg	NA	NA
TEPH	NJ-TPH-QAM 025-02/08	0.30 mg/L	TBD	20 mg/kg	TBD	NA	NA
Percent Moisture	SM 2540G (Total Solids)	NA	NA	1%	NA	NA	NA
Grain Size	ASTM D422	NA	NA	NA	NA	NA	NA
Hexavalent Chromium	3060A/7199	0.01µg/L	0.0026 µg/L	0.4 mg/kg	0.1492 mg/kg	NA	NA
pH	SW846 9045C	NA	NA	NA	NA	NA	NA
ORP	SM 2580B	NA	NA	NA	NA	NA	NA
Percent Lipids	Gravimetric, TA SOP	NA	NA	NA	NA	0.10%	0.03%

Acronyms and Abbreviations:

MDL = method detection limit
µg/L = micrograms per liter
mg/kg = miligrams per kilogram
mg/L = milligrams per liter
NA = not applicable
pH = potential of hydrogen
SQL = sample quantitation limit
TBD = to be determined
TEPH = total extractable petroleum hydrocarbon
TOC = total organic carbon

Table 6-12
Summary of Analytical Procedures

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Parameter	Technique	Extraction and Analysis Method[a]		
		Water	Tissue	Sediment
VOCs	GC/MS	SW846 5030B/8260B	NA	SW846 5035A/8260B
SVOCs	GC/MS	SW846 3520C/8270C	SW846 3541/8270C	SW846 3541/8270C
Pesticides	GC	SW846 3510C/8081A	SW846 3541/8081A	SW846 3541/8081A
Aroclor PCBs	GC	SW846 3510C/8082	SW846 3541/8082	SW846 3541/8082
PCB Congeners and Homologues[b]	HRGC/HRMS	USEPA 1668A	USEPA 1668A	USEPA 1668A
Chlorinated Herbicides	GC	SW846 8151A	SW846 8151A	SW846 8151A
PCDDs/PCDFs[c]	HRGC/HRMS	USEPA 1613B	USEPA 1613B	USEPA 1613B
TEPH	GC/FID	NJ-TPH-QAM 025-02 /08	NA	NJ-TPH-QAM 025-02/08
TAL Metals	ICP	SW846 3010A/6010B	SW846 3050B/6010B	SW846 3050B/6010B
Mercury	CVAA	SW846 7470A	SW846 7471A	SW846 7471A
Hexavalent Chromium	Colorimetric/Ion Chromatography	SW846 3060A/7199	NA	SW846 3060A/7199
Cyanide	Titration/ Colorimetric	SW846 9012A	SW846 9012A	SW846 9012A
TOC	Carbonaceous Analyzer	SM 5310B	NA	Lloyd Kahn[d]
Percent Moisture	Gravimetric	NA	NA	SM 2540G (Total Solids)
Grain Size	Gravimetric	NA	NA	ASTM D422
AVS/SEM	ICP/CVAA	NA	NA	EPA-821-R-91-100
pH	pH electrode	NA	NA	SW846 9045C
ORP	Electrometric	NA	NA	SM 2580B
Percent Lipids	Gravimetric	NA	TA SOP No. PITT-OP-0011, Rev 3	NA

Notes:

a. All methods are from USEPA SW-846 "Test Methods for Evaluating Solid Waste," Third Edition, December 1996, unless otherwise noted. Copies of the extraction methods, analytical methods and method summaries are included as appendices to this Supplemental Remedial Investigation Work Plan.

b. USEPA Method 1668A: Measurement of toxic PCB congeners by isotope dilution HRGC/HRMS (December 1999).

c. The method for PCDDs/PCDFs is USEPA Method 1613 B: Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS, Revision B (October 1994).

d. Lloyd Kahn TOC method, as modified by USEPA.

Table 6-12
Summary of Analytical Procedures

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted metals
CVAA = cold vapor atomic absorption
GC/MS = gas chromatography/mass spectroscopy
HRGC/HRMS = high resolution gas chromatography/high resolution mass spectroscopy
ICP = inductively coupled plasma emission spectroscopy
NA = not applicable
ORP = oxidation-reduction potential
PCB = polychlorinated biphenyl
PCDD/PCDF = polychlorinated dibenzodioxins/polychlorinated dibenzofurans
pH = potential of hydrogen
SOP = standard operating procedure
SVOC = semivolatile organic compound
TAL = target analyte list
TEPH = total extractable petroleum hydrocarbon
TOC = total organic carbon
USEPA = U.S. Environmental Protection Agency
VOC = volatile organic compound

Table 6-13
Test Conditions and Acceptability Criteria for the 28-Day Sediment Toxicity Test Using *Leptocheirus plumulosus*

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Test Condition	Test Acceptability Criteria
Test method	U.S. Environmental Protection Agency. 2001. Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-Associated Contaminants with the Amphipod *Leptocheirus plumulosus*. Office of Research and Development. Washington, DC EPA/600/R-01/020.
Endpoint	Survival, growth and reproduction
Test duration	28 days
Test organism: age/size class	Neonate *Leptocheirus plumulosus* amphipods of the same size and age that will pass through a 0.6 mm sieve and be retained on a 0.25 mm sieve.
Test organism: source	In-house laboratory cultures under the same conditions as testing (i.e., salinity 20 ± 2 ‰, temperature 25 ± 2ºC)
Control sediment source	Laboratory approved source
Overlying water salinity	20 ‰
Temperature	25 ± 2ºC
Photoperiod	16-hour light, 8-hour dark
Test type	Static-renewal
Test chamber size	1 liter
Number of organisms per replicate	20 organisms
Number replicate chambers per treatment	5
Light intensity	500 to 1000 lux
Light quality	Fluorescent bulbs
Number organisms per sediment sample	100 organisms
Sampling and sample holding requirements	The test is initiated within 14 days of sediment collection
Sediment depth	2 centimeters

Table 6-13
Test Conditions and Acceptability Criteria for the 28-Day Sediment Toxicity Test Using *Leptocheirus plumulosus*

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Test Condition	Test Acceptability Criteria
Test acceptability criterion	≥ 80% control survival
Test solution aeration	To prevent total dissolved oxygen from dropping below 4.4 mg/L (60% saturation at 25 ºC and 20 ‰), aeration (with oil-free air) is maintained throughout the exposure at a rate of approximately 1 to 3 bubbles per second with a 1 mL glass pipette.
Test solution volume	750 mL; renewal of 400 mL three times per week

Acronyms and Abbreviations:

% = percent
ºC = degrees Celsius
cm = centimeter
mL = milliliter
mm = millimeter

Table 7-1
Field Chemistry Quality Control Samples

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Sample Matrix/Type	Parameter	Field Duplicate	Rinsate Blank	Trip Blank
Sediment	VOCs	X	X	X
	SVOCs	X	X	
	Pesticides/PCBs	X	X	
	PCB Congeners and Homologues	X	X	
	Chlorinated Herbicides	X	X	
	PCDDs/PCDFs	X	X	
	TEPH	X	X	
	TOC	X	X	
	TAL Metals and Cyanide	X	X	
	Hexavalent Chromium	X	X	
	AVS/SEM	X		
	Moisture Content	X		
	ORP	X		
	pH	X		
	Grain Size	X		
Tissue	SVOCs	X	X	
	Pesticides/PCBs	X	X	
	PCB Congeners and Homologues	X	X	
	Chlorinated Herbicides	X	X	
	PCDDs/PCDFs	X	X	
	TAL Metals and Cyanide	X	X	
	Percent Lipids	X		

Note:
X indicates that a quality control sample is to be collected.

Acronyms and Abbreviations:

AVS/SEM = acid volatile sulfides/simultaneously extracted metals
ORP = oxidation-reduction potential
PCB = polychlorinated biphenyl
PCDD/PCDF = polychlorinated dibenzodioxins/polychlorinated dibenzofurans
pH = potential of hydrogen
SVOC = semivolatile organic compound
TAL = target analyte list
TEPH = total extractable petroleum hydrocarbons
TOC = total organic carbon
VOC = volatile organic compound

Table 7-2
Frequency of Collection of Field Chemistry Quality Control Samples

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Type of Quality Control Sample	Frequency
Rinsate Blank	1 per 20 field samples (not to exceed 1 per day)
Field Duplicate	1 per 20 field samples per matrix and per method
Trip Blank	1 trip blank will be included with each shipment of samples collected for volatile organic compound analyses

Table 7-3
Equipment Calibration and Maintenance Log

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Date	Time	Equipment Information		Calibration[a]			Inspection[b]		Maintenance[c]	
(mm/dd/yy)	(hh:mm)	Make/Model	ID/Serial Number	Initial	Check	Recalibrate	Working	Replace	Charge	Repair[d]

Notes:

a. Enter the time of each activity.
b. Enter initials in appropriate box during each calibration activity, if REPLACE, record the reason on the following line and calibrate new equipment.
c. Enter initials in appropriate box upon performing any of the listed activities.
d. Enter description of repair activity in logbook.

Table 7-4
Equipment Calibration Schedule[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Equipment Type	Frequency of Calibration
Photoionization detector	Daily prior to use
Hydrogen sulfide meter	Prior to beginning project and every six months thereafter
Fathometer	Twice daily at the beginning and end of the day
Survey equipment	Prior to beginning project and twice daily at the beginning and end of the day
Tide gage	Annually by user
pH and ORP electrode	Daily prior to use
Electronic fish scale	Daily prior to use

Note:

a. This table provides an approximate schedule for equipment calibration. In addition to this schedule, the equipment manufacturer's specifications should be followed, as appropriate.

Table 8-1
Standard Laboratory Data Qualifiers

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Qualifier	Description
B	Target Analyte List (TAL) Metals – The reported value was obtained from an instrument reading that was less than the sample quantitation limit (SQL). Organics – The associated analyte was also detected in the method blank.
D	The organic analyte was quantitated from a diluted analysis.
E	TAL Metals – The reported value is estimated due to the presence of an interference. Organics – The associated compound concentration exceeded the calibration range of the instrument.
G	Organic data indicated the presence of a compound that meets the identification criteria; the result is below the SQL but above the method detection limit MDL.
N	The TAL metals analysis is associated with a spike sample not within control limits.
P	The percent difference between the primary and confirmation column for pesticide/Aroclor analyses is greater than 40 percent.
U *	The analyte was analyzed for, but was not detected above the reported sample quantitation limit. The TAL metals duplicate analysis was not within the established quality control limit.
S +	TAL Metals – The reported value was determined by Method of Standard Additions (MSA). TAL Metals – The correlation coefficient for MSA is less than 0.995.
W	TAL Metals – The post-digestion spike for furnace atomic absorption analysis is out of control.
I	The laboratory indicated the presence of an interference during the sample analysis.

Table 8-2
Electronic Data Deliverable Format[a]

Hackensack River Study Area
Supplemental Remedial Investigation Work Plan

Field Name[b]	Maximum Length	Data Type	Comments
FIELD SAMPLE ID	50	TEXT	FROM THE CHAIN OF CUSTODY. ADD "RE" -OR- "DL" TO DIFFERENTIATE RE-ANALYSES AND DILUTIONS.
SDG	50	TEXT	
LAB SAMPLE ID	50	TEXT	
MATRIX	10	TEXT	SOIL, WATER, SEDIMENT, ETC.
SAMPLE TYPE	10	TEXT	FB, RB, TB, FD, FS FOR FIELD BLANK, RINSE BLANK, TRIP BLANK FIELD DUPLICATE, AND FIELD SAMPLE, RESPECTIVELY. DEFAULT TO FS.
DATE COLLECTED	--	DATE/TIME	MM/DD/YY
TIME COLLECTED*	--	DATE/TIME	MILITARY TIME
DEPTH START	—	NUMBER	
DEPTH END	--	NUMBER	
DEPTH UNITS	25	TEXT	FEET, INCHES, METERS, ETC.
ANALYTICAL	50	TEXT	
CAS NUMBER	25	TEXT	
ANALYTE	100	TEXT	
RESULT VALUE	—	NUMBER	FOR NON-DETECTED RESULTS, ENTER REPORTING LIMIT (SQL) ("U" MUST BE PRESENT IN LAB QUALIFIER FIELD).
LAB QUALIFIER	10	TEXT	"U" FOR NON-DETECTED, OTHERS AS DEFINED BY
REPORTING LIMIT (SQL)	--	NUMBER	
METHOD DETECTION LIMIT	--	NUMBER	
RESULT UNIT	25	TEXT	
DILUTION FACTOR	--	NUMBER	
REPORTABLE RESULT	—	YES/NO	DEFAULT TO YES
FILTERED?	--	YES/NO	
DATE ANALYZED	--	DATE/TIME	MM/DD/YY
TIME ANALYZED*	—	DATE/TIME	MILITARY TIME
DATE EXTRACTED*	--	DATE/TIME	MM/DD/YY
LABORATORY	50	TEXT	

Notes:

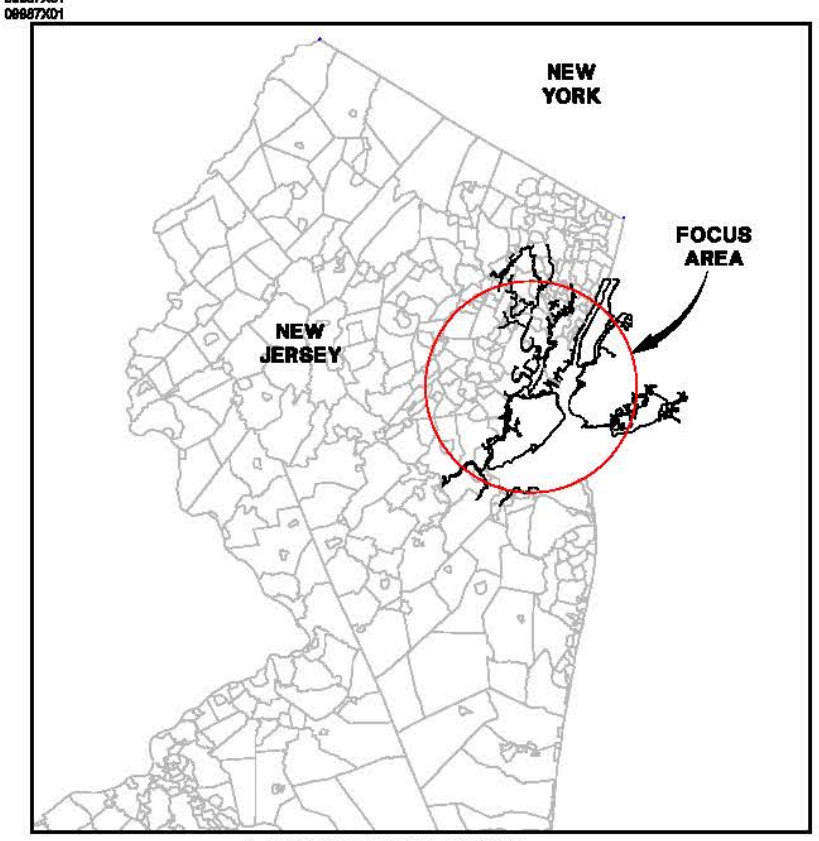
a. This definition is for an Excel spreadsheet. Fields flagged with an asterisk (*) are optional and may be left blank if not available electronically from the laboratory.

b. Depth-related fields may be left blank for samples and matrices for which they are not applicable.

ARCADIS

Figures

CITY: SYRACUSE DIV/GROUP: 141/ENV DB: LAF KLS KEW LD:(Opt) PIC:(Opt) PM: MB TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACTIVE\0009987\0000\0023\DWG\09987G02.DWG LAYOUT: 1-1 SAVED: 1/15/2009 12:36 PM ACADVER: 17.0S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 1/16/2009 12:37 PM BY: WOOD, KATE
XREFS: IMAGES: PROJECTNAME: —
09987X01
09987X01



LOCATION MAP

DUNDEE DAM
SADDLE RIVER
BELLMAN'S CREEK
BERGEN COUNTY
THIRD RIVER
BERRY'S CREEK CANAL
BERRY'S CREEK
CROMAKILL CREEK
SECOND RIVER
KINGSLAND CREEK
FRANK'S CREEK
SAWMILL CREEK
HACKENSACK RIVER STUDY AREA
PASSAIC RIVER
LAWYER'S CREEK
HARRISON CREEK
HUDSON COUNTY
PLUM CREEK
ESSEX COUNTY
PIERSON'S CREEK
PORT NEWARK
PORT NEWARK CHANNEL
NEWARK BAY
NEWARK LIBERTY INTERNATIONAL AIRPORT
ELIZABETH CHANNEL
UNION COUNTY
PERIPHERAL DITCH
PORT ELIZABETH
SOUTH ELIZABETH CHANNEL
UPPER NEW YORK BAY
PLATYKILL CREEK
ARLINGTON MARSH
ELIZABETH RIVER
SHOOTERS ISLAND
KILL VAN KULL
MORSES CREEK
MARINERS MARSH
OLD PLACE CREEK
PILES CREEK
PRALLS ISLAND
RAHWAY RIVER
STATEN ISLAND
FRESH KILLS
ARTHUR KILL
MIDDLESEX COUNTY

NOTE:

1. BASEMAP INFORMATION FROM NOAA CHARTS 12331, 12333, AND 12337, DATED MAY 4, 1995.

0 .5 1 1.5 2 2.5 3 4 5
km
miles

HACKENSACK RIVER STUDY AREA
SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

HACKENSACK RIVER REGIONAL MAP

ARCADIS

FIGURE
1-1

CITY: SYR DIV/GROUP: SYE40 DB: MTK KEW PM: MB
Tierra (B00099870000.00023)
W:\GIS\Hackensack\SupplementalRI_BERA\mxd\Site Study Area and Features.mxd - 1/29/2009 @ 9:59:26 AM

CONRAIL RAILROAD BRIDGE
APPROXIMATE UPSTREAM BOUNDARY
TIDE GATE 4
TIDE GATE 3
TIDE GATE 2
TIDE GATE 1
NEW JERSEY TURNPIKE BRIDGE
DIAMOND SHAMROCK SITE
AMTRAK RAILROAD BRIDGE
MUDFLAT 9
MUDFLAT 10
MUDFLAT 12
OUTFALL 14
OUTFALL 13
OUTFALL 12
OUTFALL 16
OUTFALL 15
TURNING BASIN
OUTFALL 11
OUTFALL 10
OUTFALL 9
MUDFLAT 11
MUDFLAT 8
STANDARD CHLORINE CHEMICAL COMPANY, INC. SITE
MUDFLAT 7
KOPPERS SEABOARD SITE
MUDFLAT 6
MUDFLAT 5
CONRAIL RAILROAD BRIDGE
OUTFALL 8
MUDFLAT 2
OUTFALL 7
OUTFALL 6
OUTFALL 5
OUTFALL 2
OUTFALL 1
OUTFALL 4
MUDFLAT 4
OUTFALL 3
NEWARK & JERSEY CITY TURNPIKE BRIDGE
MUDFLAT 3
CONRAIL RAILROAD BRIDGE
MUDFLAT 1
APPROXIMATE DOWNSTREAM BOUNDARY
MARION REACH

LEGEND:
- OUTFALL
- TIDE GATE
- MUDFLAT
- PROPERTY BOUNDARY
- REACH BOUNDARY
- STUDY AREA BOUNDARY
- NAVIGATION CHANNEL

0 1,000 2,000 Feet
GRAPHIC SCALE

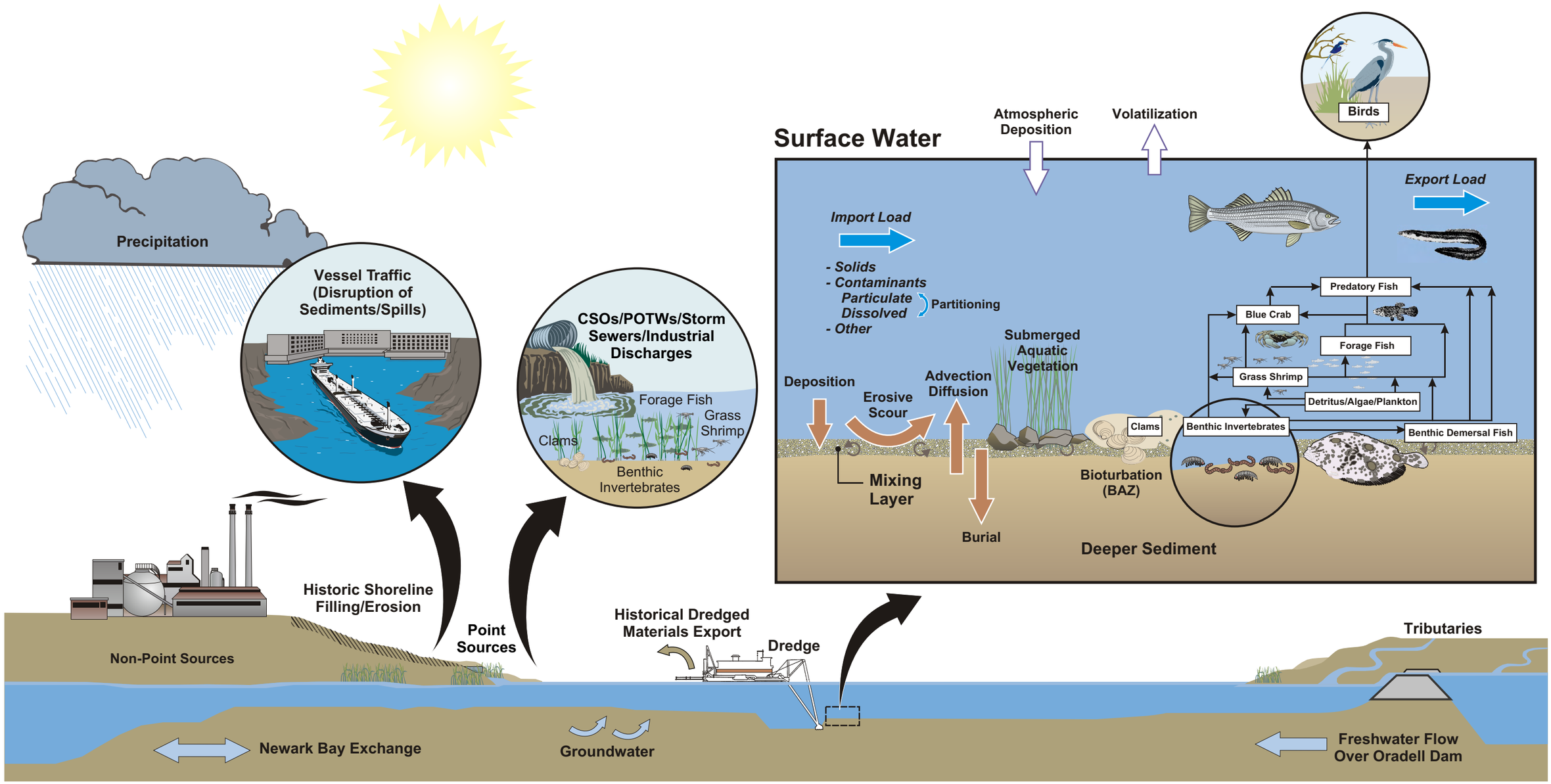
NOTES:
1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. AERIAL PHOTO DATED JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. NAVIGATION CHANNEL DIGITIZED FROM NAUTICAL CHARTS 12337 22nd ED., NOVEMBER 15, 1997 AND 12333 32nd ED., OCTOBER, 2002.
4. MUDFLAT AND OUTFALL LOCATIONS WERE RECORDED DURING THE RECONNAISSANCE PROGRAM (MARCH/APRIL 2005) USING DGPS. HOWEVER, ACTUAL LOCATIONS (RELATIVE TO THAT SHOWN ON THIS FIGURE) MAY VARY SLIGHTLY.
5. THE RECONNAISSANCE PROGRAM ONLY IDENTIFIED THE LENGTH OF A GIVEN MUDFLAT ALONG THE SHORELINE; ITS EXTENSION INTO THE RIVER WAS NOT MEASURED/DEFINED.

HACKENSACK RIVER STUDY AREA
SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

HACKENSACK RIVER STUDY AREA AND FEATURES

ARCADIS

FIGURE
1-2



HACKENSACK RIVER STUDY AREA

SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

CONCEPTUAL SITE MODEL OF HACKENSACK RIVER FATE AND TRANSPORT PROCESSES

ARCADIS

FIGURE **2-1**

01/15/09 SYRACUSE,NY-ENV/141-DJH-KLS
B0009987/0000/00023/CDR/09987G01.CDR

SYR-85 KEW
Tierra Hackensack (B0009987.0000.00023)
W:\GIS\Hackensack\SupplementalRI_BERA\mxd\Proposed Samples_v2.mxd - 1/29/2009 @ 10:15:53 AM

LEGEND:
- PREVIOUS CORING LOCATION
- 20-FT CORE
- 4-FT CORE
- SEDIMENT TRIAD AND FORAGE FISH/CRAB TISSUE SAMPLING LOCATION
- SEDIMENT TRIAD SAMPLING LOCATION
- RECONNAISSANCE PROGRAM SEDIMENT PROBING TRANSECT
- HACKENSACK RIVER STUDY AREA BOUNDARY
- MUDFLAT
- HACKENSACK RIVER SHORELINE
- GILL NET

TR30, TR29, TR28, TR27, TR26, TR25, TR24, TR23, TR22, TR21, TR20, TR19, TR18, TR17, TR16, TR15, TR14, TR13, TR12, TR11, TR10, TR9, TR8, TR7, TR6, TR5, TR4, TR3, TR2, TR1

035, 036, 034, 063, 038, 037, 064, 032, 031, 057, 002, 075, 030, 001, 029, 065, 062, 056, 028, 027, 026, 066, 055, 025, 024, 023, 022, 021, 067, 061, 054, 053, 052, 051, 020, 019, 018, 017, 016, 068, 015, 014, 013, 069, 012, 011, 070, 010, 009, 071, 060, 007, 050, 049, 048, 074, 072, 008, 073, 059, 005, 046, 006, 045, 047, 003, 041, 039, 040, 058, 004, 042, 043, 044

MUDFLAT 12
MUDFLAT 10
MUDFLAT 9
MUDFLAT 11
MUDFLAT 2
MUDFLAT 7
MUDFLAT 6
MUDFLAT 5
MUDFLAT 4
MUDFLAT 3
MUDFLAT 1

TIDE GAGE STATION

APPROXIMATE AREA OF PROPOSED OIL-LIKE SUBSTANCE DELINEATION; REFER TO FIGURE 4-2

NOTES:
1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. RIVER OUTLINE DIGITIZED FROM AERIAL PHOTOGRAPHS DATED MAY 2002 AND JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. ALL LOCATIONS ARE APPROXIMATE AND MAY CHANGE DEPENDING ON FIELD CONDITIONS.

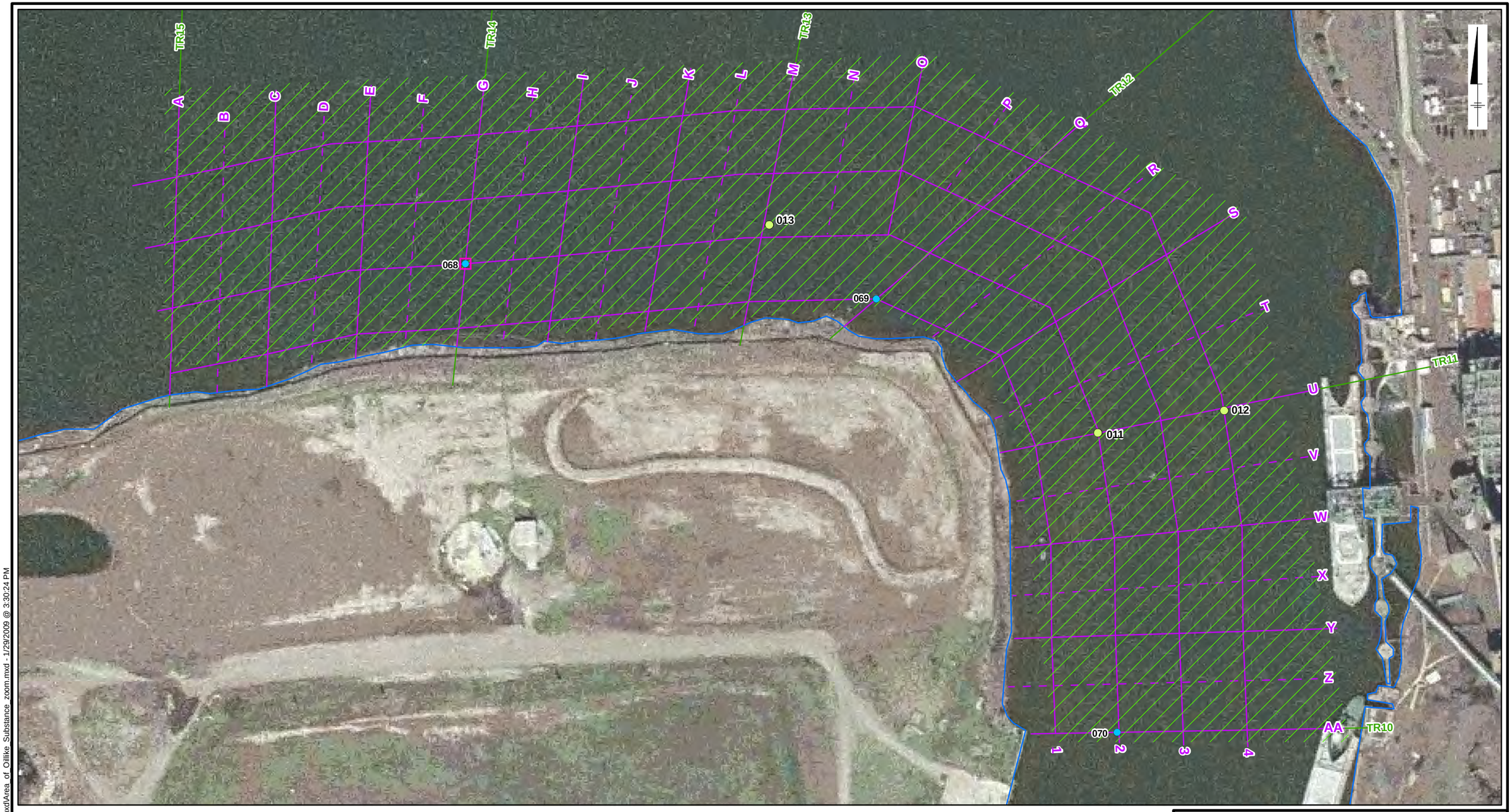
0 1,000 2,000 Feet
GRAPHIC SCALE

HACKENSACK RIVER STUDY AREA
SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

PROPOSED SAMPLING LOCATIONS

ARCADIS

FIGURE 4-1



LEGEND:

- PREVIOUS SEDIMENT CORE WITH OIL-LIKE SUBSTANCE
- 4-FT CORE
- SEDIMENT TRIAD AND FORAGE FISH/CRAB TISSUE SAMPLING LOCATION
- SEDIMENT TRIAD SAMPLING LOCATION
- AREA OF OIL-LIKE SUBSTANCE DELINEATION
- DELINEATION TRANSECT (100-FT SPACING)
- DELINEATION TRANSECT (50-FT SPACING)
- RECONNAISSANCE PROGRAM SEDIMENT PROBING TRANSECT
- MUDFLAT
- HACKENSACK RIVER SHORELINE

NOTES:

1. HORIZONTAL DATUM: NEW JERSEY STATE PLANE COORDINATE SYSTEM, NAD83.
2. RIVER OUTLINE DIGITIZED FROM AERIAL PHOTOGRAPHS DATED MAY 2002 AND JULY 2002 (INTRASEARCH, ENGLEWOOD, CO).
3. ALL LOCATIONS ARE APPROXIMATE AND MAY CHANGE DEPENDING ON FIELD CONDITIONS.
4. DELINEATION OF OIL-LIKE SUBSTANCE AT APPROXIMATE 50 TO 100 FT INTERVALS IS PROPOSED IN THE AREA INDICATED. ACTUAL LOCATIONS AND NUMBER OF DELINEATION CORES WILL BE DEPENDENT ON FIELD OBSERVATIONS.

0 150 300 Feet

GRAPHIC SCALE

HACKENSACK RIVER STUDY AREA

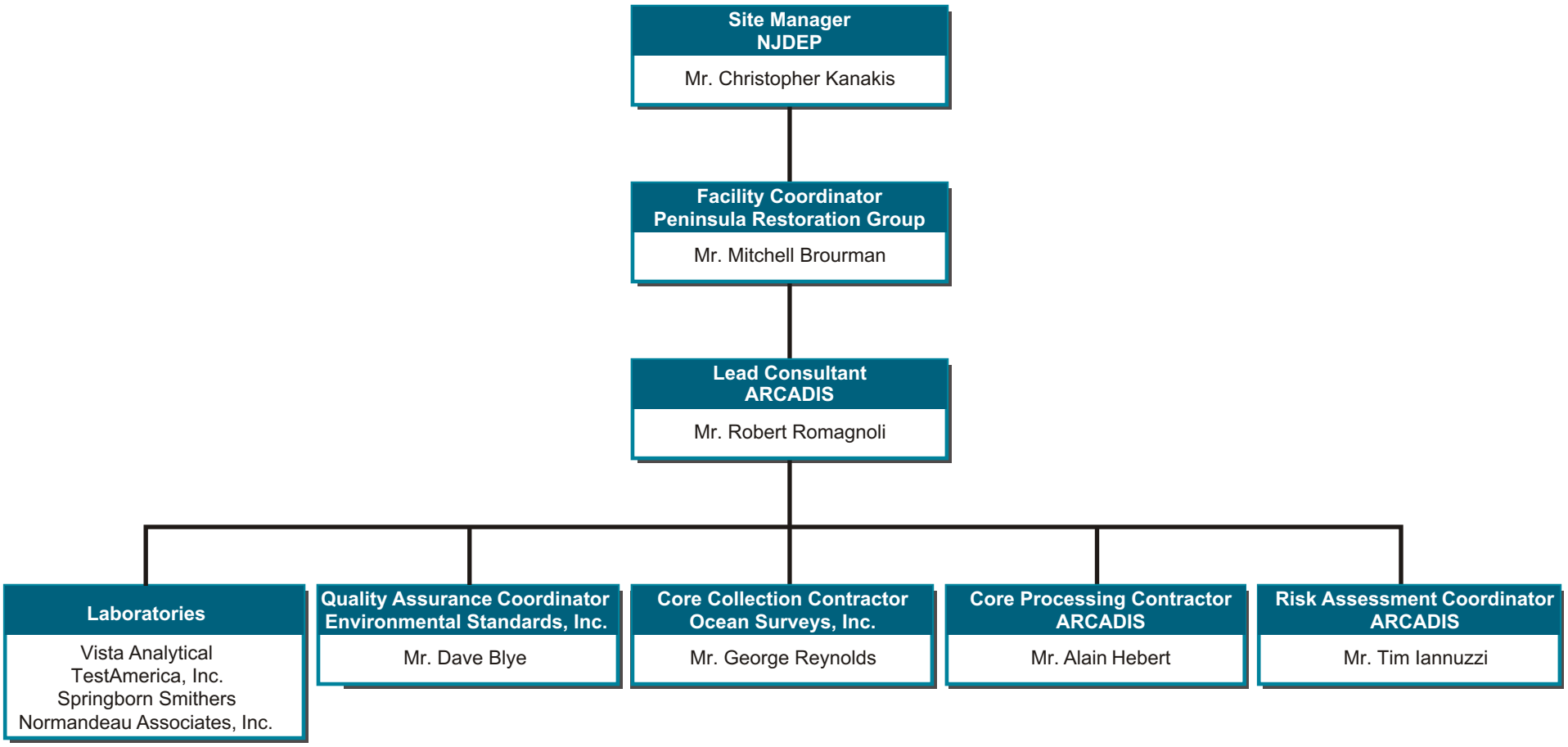
SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

AREA OF OIL-LIKE SUBSTANCE DELINEATION SAMPLING

ARCADIS

FIGURE 4-2

SYR-85 KEW
Tierra Hackensack (B0009987.0000.00023)
W:\GIS\Hackensack\SupplementalRI_BERA\mxd\Area_of_Oillike_Substance_zoom.mxd - 1/29/2009 @ 3:30:24 PM



NOTES:

1. Each company will designate an internal QA/QC Manager who will communicate with the Lead Consultant PM, as necessary.

2. Companies/Individuals considered for use within the various tasks identified in the chart are presented in Section 5.1 of the text.

HACKENSACK RIVER STUDY AREA

SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

PROJECT ORGANIZATION

ARCADIS

FIGURE
5-1

FIGURE 9-1

CORRECTIVE ACTION FORM

Project Name: _____

Project Number: _____

Preparer: _____

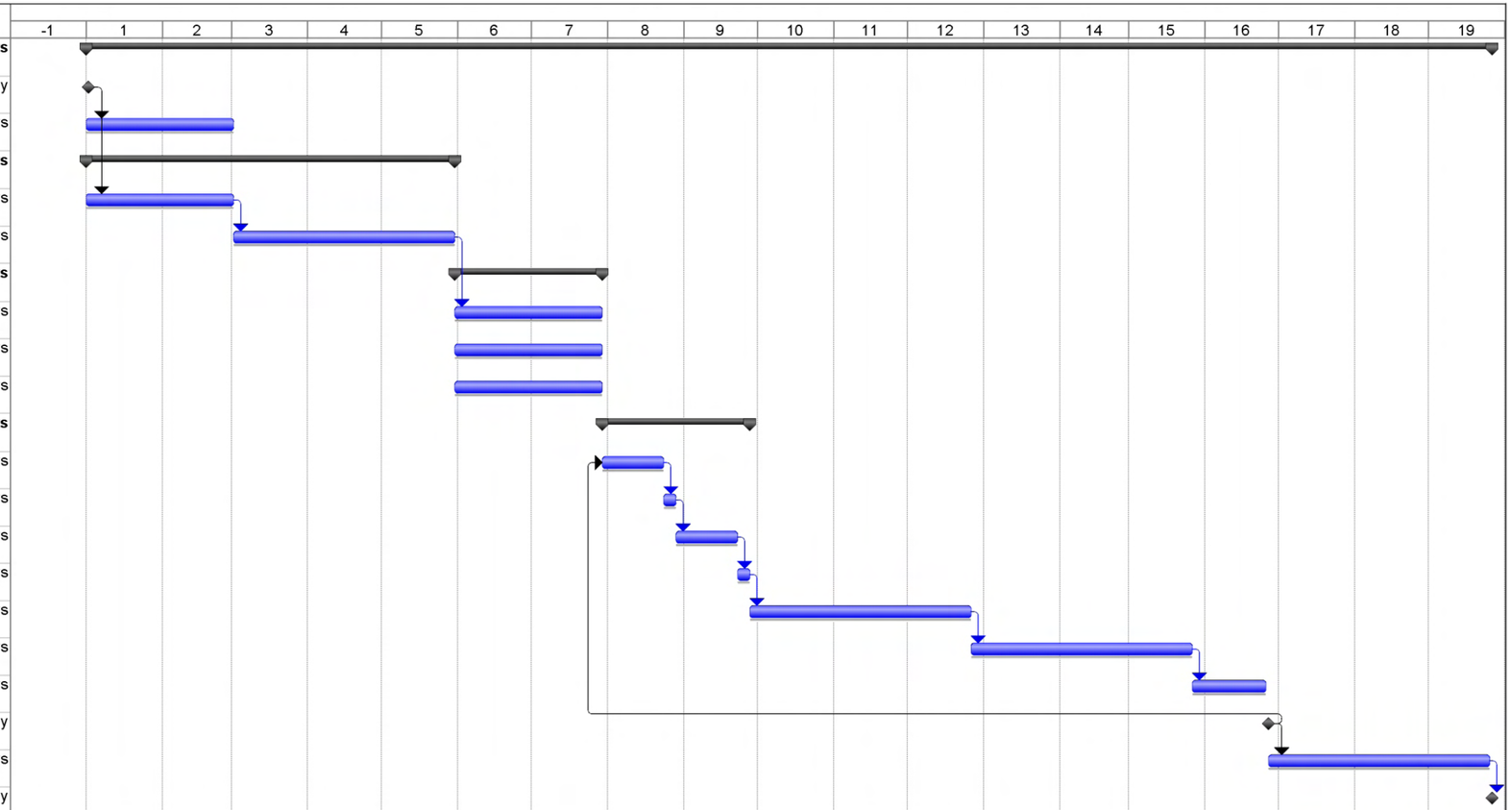
Date Prepared: _____

Description of Deviation	
Date(s) of Event(s):	Affected Plan/Section

Summary of Resolution

Corrective Action Approved by:			
Preparer:		Date:	
Task Leader:		Date:	
Facility Coordinator:		Date:	

ID	Work Activity	Estimated Duration
1	**Supplemental Remedial Investigation Program**	**572 days**
2	NJDEP Approval of SRIWP	1 day
3	NJDEP Approval of Background/Reference Locations	60 days
4	**Permitting**	**150 days**
5	Permit Application Preparation	60 days
6	Permit Approval	90 days
7	**Pre-Mobilization Tasks**	**60 days**
8	Contractor Selection	60 days
9	Staging Area Planning/Coordination	60 days
10	Utility Identification/Clearance	60 days
11	**Implement Field Work**	**60 days**
12	Final Planning/Coordination	25 days
13	Mobilization	5 days
14	Sediment Sampling/Processing	25 days
15	Demobilization	5 days
16	Laboratory Analyses/Data Validation	90 days
17	Data Review and Preparation of Technical Memoranda	90 days
18	NJDEP Review of Technical Memoranda	30 days
19	Meeting with NJDEP	1 day
20	Supplemental Remedial Investigation Report (SRIR) Preparation	90 days
21	Submit SRIR	1 day



LEGEND:

Task

Milestone

Summary

NOTES:

1. Estimated durations are in calendar days.
2. If revisions to the SRIWP are necessary, this schedule will be adjusted accordingly.
3. All of the estimated durations are dependent on (amongst other things) permitting requirements, availability of subcontractors, and weather, and are therefore subject to change.
4. Considerations to be evaluated during the meeting with NJDEP include the need to collect additional data, concurrence on a path forward, and a schedule for upcoming activities.
5. If additional field work is planned as per outcome of the meeting and as depicted above, a revised schedule will be provided to the NJDEP for review and approval.

HACKENSACK RIVER STUDY AREA

SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

ESTIMATED SCHEDULE

ARCADIS

FIGURE **11-1**

ARCADIS
Infrastructure, environment, buildings

Imagine the result

Standard Operation Procedure No 1

Field Documentation

January 2009

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for documenting field activities associated with the Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP). The appropriate documentation of field activities provides an accurate and comprehensive record of the work performed that is sufficient for a technical peer to reconstruct the day's activities and determine that necessary requirements were met. Additional details are provided in the SRIWP.

This SOP may change depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Facility Coordinator and the New Jersey Department of Environmental Protection Site Manager. The ultimate procedure employed will be documented in the Supplemental Remedial Investigation Report for the HRSA.

Other SOPs will be utilized in conjunction with this procedure, including:

- SOP No. 2 – Decontamination
- SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 4 – Positioning
- SOP No. 5 – Habitat Characterization
- SOP No. 6 – Sediment Collection Using Hand Coring Device
- SOP No. 7 – Sediment Collection Using Vibracoring Device
- SOP No. 8 – Core Processing
- SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests
- SOP No. 10 – Benthic Invertebrate Community Sampling
- SOP No. 11 – Fish Tissue Sampling
- SOP No. 12 – Crab Tissue Sampling

- SOP No. 13 – Management and Disposal of Residuals
- SOP No. 14 – Tide Gage Installation

2. Procedures

2.1 General Requirements

Pertinent field information will be recorded in a logbook and/or on an appropriate form (as described herein) in black, ballpoint pen. The field forms may be replaced with an electronic field database. A key that describes each entry is provided for each form. Logbook entries will be factual and observational (i.e., no speculation or opinion), and will not contain any personal information or non-project-related entries. Separate and dedicated logbooks will be kept for different operations running concurrently (e.g., core collection onboard the vessel, core processing at the Sample Processing Area); individual tasks making up each operation will be maintained in the same logbook, if possible. The cover and binding of each logbook will be labeled to identify the operation and dates included with the logbook; each page in the logbook will be consecutively numbered.

A page header will appear on the first page of each day's notes in the logbook, and activities for each day will be recorded on a new page. The page header will include: name of author and other personnel on site (and affiliated organization, if applicable).

- date
- time of arrival
- current weather and tidal conditions
- weather forecast for the day

An abbreviated header, limited to the date, will appear at the top of each additional page for the active date. Field forms (included in this SOP) will require similar header information.

Field activities and other events pertinent to the field activities will be documented in chronological order. Times will be recorded using Eastern Standard Time (EST) notation for each entry. At a minimum, documentation in a logbook will include the following:

- names of visitor(s) to the work location being documented in the log, including time of arrival and departure, the visitor's affiliation, and reason for the visit
- summary of project-related communications, including names of people involved and time of communications
- time daily work commences and ceases
- start and stop times of new tasks
- start and stop times of breaks
- safety or other monitoring data, including units with each measurement
- deviations from the scope of work
- progress updates
- problems/delays encountered
- unusual events
- signature or initials of author on every page

A single line will be drawn through incorrect entries and the corrected entry written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.

If there are additional lines on the page at the end of the day's activities, a line will be drawn through the empty space, and it will be initialed and dated, leaving no room for additional entries.

The logbook will cross-reference information documented in the field forms.

Photographs will be identified in the logbook by a unique numbering system. If photographs are collected by a digital camera, the file number as well as the photograph number will accompany the description of the photograph in the logbook. At a minimum, the time the photograph was taken, the general location of the photograph, a brief description, and the photographer's name will be recorded. Additional information may include: Differential Global Positioning System (DGPS) coordinates, direction the photographer was facing, and/or weather conditions. If necessary, an object will be included to indicate the scale of the object in the photograph.

2.2 Additional Requirements

This section presents specific documentation requirements for activities to be performed. It is meant to provide guidance to project staff responsible for field documentation during these activities, and is not intended to be a comprehensive list of activities performed. These documentation procedures are meant to supplement, not replace, the required documentation presented in Section 2.1.

As briefly described in Section 2.1, eight field forms were developed for the SRIWP to ensure that the proper documentation of field information is obtained in a consistent manner. The purpose of each form is described below.

- Daily Activity Log – Provides a summary of daily vessel logistics during the SRIWP activities including personnel present, equipment used, and weather conditions.

- Individual Core Collection Form – Provides core-specific information such as penetration and recovery measured during core collection. The Individual Core Collection Form also serves as the chain-of-custody for the core as it is transported from the coring vessel to the Sample Processing Area.

- Grab Sample Collection Form – Provides a summary of grab sample information.

- Core Lithology/Description Form – Provides a lithological description of a core observed during sample processing.

- Sample Processing Form – Provides specific information about sample processing, including core segmentation.

- Fish Data Form and Fish Pathology Form – Provides sample-specific information for the mummichog and large predatory fish tissue samples.

- Blue Crab Data Form – Provides sample-specific information for the blue crab tissue samples.

2.2.1 Equipment Calibration and Maintenance

Equipment calibration will be recorded in a logbook. Instrument information, including the instrument manufacturer, model number, and serial number, will be recorded. Instrument calibration will be performed in accordance with the manufacturer's specifications and at the frequency specified in Table 7-2 of the SRIWP. Values measured during calibration will be recorded in the logbook. In addition, maintenance, problems, and repairs to the equipment will be recorded in the logbook. Equipment

information, calibration, inspection, and maintenance will be documented in Table 7-3 of the SRIWP.

2.2.2 Vessel Positioning

Information regarding vessel positioning will be recorded in the Daily Activity Logs and the Individual Core Collection Forms, both of which are attached to this SOP.

2.2.3 Core Collection

Documentation of core collection will be recorded in the Daily Activity Logs and the Individual Core Collection Forms, both of which are attached to this SOP.

2.2.4 Grab Sample Collection

Documentation of grab sample collection will be recorded in the Daily Activity Logs and Grab Sample Forms, both of which are attached to this SOP.

2.2.5 Tissue Sample Collection and Processing

Documentation of tissue sample collection and processing will be recorded in the Daily Activity Logs, and the Fish Data, Fish Pathology, and Blue Crab Data Forms, all of which are attached to this SOP. Additional information is provided in SOP No. 11 - Fish Tissue Sampling and SOP No. 12 - Crab Tissue Sampling.

2.2.6 Core and Mudflat Grab Sample Processing

Documentation of core processing will be recorded in the Core Lithology/Description Form and Sample Processing Form, both of which are attached to this SOP. Documentation of mudflat grab sample processing will also be recorded in the Sample Processing Form. Additional information that should be considered for entry into the logbook includes:

- date and time (core processing and individual sample collection)
- names of the members of the processing crew
- location ID
- preservative (if necessary)
- processing procedures and equipment

- Quality Assurance samples (matrix spike/matrix spike duplicate or matrix spike/duplicate), if requested

Sample information should be included in a logbook, as well as on the chain-of-custody form and sample container label.

2.2.7 Sample Handling and Shipping Procedures

Activities associated with the handling and shipping of samples will be recorded in a logbook. In addition to meeting the general requirements presented in Section 2.1, sample handling and shipping documentation will include:

- date and time sample custody was relinquished
- organization/representative receiving custody
- name of analytical laboratory
- tracking number (if using commercial shipping company)
- sample delivery group (SDG) tracking log number (for internal tracking purposes; see Section 8.2.2 of the SRIWP for a description of SDG)

2.3 Distribution and Maintenance of Field Documentation

Logbooks, field forms, and chain-of-custody forms/SDG tracking logs will be filed according to the SRIWP.

Logbooks that are taken off site from the field offices will be photocopied and filed at the end of each day to mitigate against the loss of historical entries should the logbook be lost in the field.

Field data forms and chains-of-custody/SDG tracking logs will be filed once they have been completed and distributed (if necessary), or at the end of each field day.

Distribution of daily forms will be performed according to the needs of the project team and at the direction of the Lead Consultant Project Manager (PM) or designee.

Upon completion of sampling and transfer of samples to the shipping company or courier, copies of the signed chains-of-custody and SDG tracking logs will be faxed to the Lead Consultant PM, appropriate analytical laboratory contact, and the data

validator. Copies of these documents will also be maintained at the field office in a labeled three-ring binder in reverse chronological order.

3. Quality Assurance

Entries in the field forms (i.e., Daily Activity Log, Individual Core Collection Form, Grab Sample Collection Form, Core Lithology/Description Form, and Sample Processing Form) will be reviewed by the samplers to verify the information is correct. Completed field forms will be reviewed periodically by the Lead Consultant PM or designee to verify that the requirements are being met.

DAILY ACTIVITY LOG
(Sheet 1 of 2)

I.	Date: (1)			
II.	Vessel Name: (2)			
III.	Personnel (Name/Affiliation/Role): (3)			
IV.	Equipment on Board:	Name/Type	Model No.	Serial No.
	Coring Device:	(4)	(5)	(6)
	Grab Sample Device:			
	DGPS:			
	Fathometer:			
	Other:			
V.	Weather Forecast Checked?: Yes No (7)			
VI.	Time of High and Low Tide Checked? Yes No (8)			

DAILY ACTIVITY LOG
(Sheet 2 of 2)

I.	Date: (1)		
VII.	Health and Safety Briefing Topic: (9)		
VIII.	Notification:		
	Agency	Contact	Time (EST)
	(10) Vessel Tracking Service Bridge Operator	(11)	(12)
IX.	Time of Departure from Marina: (13) EST		
X.	Time of Return to Marina: (14) EST		
XI.	Name of Person Responsible for Log: (15)		

DAILY ACTIVITY LOG KEY
(Sheet 1 of 1)

DESCRIPTION OF ITEMS:

(1) Date of activity (e.g., 1/1/2009).

(2) Name of vessel performing activity.

(3) Personnel on vessel, including name, affiliation, and role on the vessel.

(4) Name or type of equipment (e.g., for DGPS, enter Trimble); if specific equipment type not listed, enter under "Other."

(5) Model number of equipment (e.g., for DGPS, enter 7400).

(6) Serial number of equipment (if available).

(7) Weather forecast checked via marine radio, Newark Liberty International Airport, etc.

(8) Time of High and Low Tide for the day checked via NOAA/National Ocean Service's website.

(9) Significant topic(s) discussed at daily health and safety briefing.

(10) Name of agency(ies) notified of daily activities.

(11) Agency(ies) contact name(s).

(12) Time that agency(ies) was(were) contacted.

(13) Time of departure from the marina at the beginning of the day (EST).

(14) Time of return to the marina at the end of the day (EST).

(15) Name of person entering information into this form.

INDIVIDUAL CORE COLLECTION FORM
(Sheet 1 of 4)

I.	Date: (1)
II.	Core ID: (2)
III.	Sediment Collection Method (circle one): (3) - Vibracoring - Hand Coring
IV.	Coordinates: Target Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (4) - Easting (ft): (5) Final Positioning Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (6) - Easting (ft): (7) Confirm final core location coordinates are within 10 feet of target coordinates (8) Final Core Location Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (9) - Easting (ft): (10) Confirm final core location coordinates are within 50 feet of target coordinates (11)
V.	Water Depth at Time of Coring (ft): (12)

INDIVIDUAL CORE COLLECTION FORM
(Sheet 2 of 4)

I.	Date: (1)
II.	Core ID: (2)
VI.	Start Time of Coring (EST): (13) End Time of Coring (EST): (14)
VII.	Penetration: - Target Penetration (ft): (15) - Actual Penetration (ft): (16) - Penetration (%): (17) $\text{Penetration (\%)} = \frac{\text{Actual Penetration (feet)}}{\text{Target Penetration (feet)}} \times 100$ If Penetration (%) ≥ 75%, then penetration is acceptable. If Penetration (%) < 75%, then refer to either SOP No. 6, Section 2.2.4, or SOP No. 7, Section 2.2.4, depending on coring method. Refusal? (circle one): Yes No (18)
VIII.	PID Reading: (19) **Breathing Zone Action Levels:** For total hydrocarbon levels >5 ppm, upgrade to Level C PPE. For total hydrocarbon levels >25 ppm, stop work. For hydrogen sulfide levels >5 ppm, stop work, evacuate work area, and ventilate.

INDIVIDUAL CORE COLLECTION FORM
(Sheet 3 of 4)

I.	Date: (1)
II.	Core ID: (2)
IX.	Recovery: - Recovery (ft): (20) - Recovery (%): (21) $\text{Recovery (\%)} = \frac{\text{Recovery (ft)} - \text{Gaps (ft)}}{\text{Actual Penetration (ft)}} \times 100$ - Gaps Identified (22) If Recovery (%) ≥ 75%, then recovery is acceptable. If Recovery (%) < 75%, then refer to either SOP No. 6, Section 2.2.5, or SOP No. 7, Section 2.2.5, depending on coring method.
X.	Final Disposition of Core (circle one): (23) - Retained for Processing - Rejected If rejected, reason for rejection: (24)

INDIVIDUAL CORE COLLECTION FORM
(Sheet 4 of 4)

I.	Date: (1)
II.	Core ID: (2)
XI.	Notes (see logbook for additional information): (25)
XII.	Name of Person Responsible for Log: (26)

Relinquished By (27) Company (28) Date (29) Time (30)
Accepted By (31) Company (32) Date (33) Time (34)

Relinquished By _____ Company _____ Date _____ Time _____
Accepted By _____ Company _____ Date _____ Time _____

INDIVIDUAL CORE COLLECTION FORM KEY
(Sheet 1 of 2)

DESCRIPTION OF ITEMS:

(1) Date of coring (e.g., 1/1/2009).

(2) Core ID (e.g., HRSRSED030B); refer to SOP No. 3, Section 2.2.1, for core identification code.

(3) Sediment collection method used (e.g., vibracoring or hand coring).

(4) Target Northing coordinate in feet from Table 4-4 or Table 4-5 of SRIWP.

(5) Target Easting coordinate in feet from Table 4-4 or Table 4-5 of SRIWP.

(6) Final Position Northing coordinate in feet.

(7) Final Position Easting coordinate in feet.

(8) Confirm the final position location is within 10 feet of the target location (refer to SOP No. 4).

(9) Final Northing coordinate of core collection location in feet. This location may be different than (4) due to the adjustment of vessel position for multiple core attempts at the same location (refer to SOP No. 4).

(10) Final Easting coordinate of core collection location in feet. This location may be different than (5) due to the adjustment of vessel position for multiple core attempts at the same location (refer to SOP No.4).

(11) Confirm the final location is within 50 feet of the target location; refer to SOP No. 4.

(12) Water depth at core collection location in feet.

(13) Time core collection with vibracoring or hand coring device is started in EST.

(14) Time core collection with vibracoring or hand coring device is finished in EST.

(15) Target penetration in feet with vibracoring or hand coring device; from Table 4-4 or Table 4-5 of SRIWP.

(16) Actual penetration of core into sediment. Actual penetration is the depth advanced into the sediment not including the depth advanced to form a sediment "plug."

Actual penetration (ft) = Penetration (ft) – "plug" (ft)

INDIVIDUAL CORE COLLECTION FORM KEY
(Sheet 2 of 2)

(17) Penetration (%) - calculated according to formula on form.

(18) If penetration < 75%, indicate if refusal was encountered.

(19) PID reading in the breathing zone upon screening core; action levels from Section 6.1 of the HASP.

(20) Recovery (ft) = sediment length in core. To identify gaps, visually inspect the core for signs of separation of the sediments within the core, smears on the core tube walls or a water layer within the sediments. Measure the distance between the top and bottom of these interfaces to obtain the length(s) of the gap(s).

(21) Recovery (%) = sediment length in core per actual penetration.

(22) Record any gaps identified. Record approximate location (feet below the sediment surface) and the size of the gap (feet). For example, "0.1 foot gap observed at 1.5 feet below sediment surface."

(23) Final disposition of core (e.g., retained for processing or rejected).

(24) Provide explanation for rejecting core (e.g., recovery < 75%).

(25) Provide notes pertinent to core collection (e.g., aborted core collection due to weather); additional details may be provided in logbook.

(26) Name of person entering information into this form.

(27) Name of personnel relinquishing core.

(28) Company affiliation of personnel relinquishing core.

(29) Date core is relinquished.

(30) Time core is relinquished.

(31) Name of personnel accepting core.

(32) Company affiliation of personnel accepting core.

(33) Date core is accepted.

(34) Time core is accepted.

GRAB SAMPLE COLLECTION FORM
(Sheet 1 of 3)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Grab Sample ID: (4)
III.	Geographic Description: (5)
IV.	Weather at Time of Grab Sample: - Wind Speed/Direction: (6) - Temperature: (7) - Precipitation: (8) - Cloud Cover: (9) - Sea State: (10)

GRAB SAMPLE COLLECTION FORM
(Sheet 2 of 3)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Grab Sample ID: (4)
V.	Coordinates: Target Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (11) - Easting (ft): (12) Final Positioning Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (13) - Easting (ft): (14) Confirm final positioning coordinates are within 10 feet of target coordinates (15) Final Grab Sample Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (16) - Easting (ft): (17) Confirm final grab sample location coordinates are within 50 feet of target coordinates (18)
VI.	Water Depth at Time of Grab Sampling (ft): (19)
VII.	Time of Grab Sample Collection (EST): (20)
VIII.	Grab Collection: Adequate collection to meet sample requirements? (circle one): Yes No (21)

GRAB SAMPLE COLLECTION FORM
(Sheet 3 of 3)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Grab Sample ID: (4)
IX.	Notes (see logbook for additional information): (22)
XI.	Name of Person Responsible for Log: (26)

GRAB SAMPLE COLLECTION FORM KEY
(Sheet 1 of 2)

DESCRIPTION OF ITEMS:

(1) Date of grab sampling (e.g., 1/1/2009).

(2) Start of grab sample collection activities.

(3) End of grab sample collection activities.

(4) Grab Sample ID (e.g., HRSRSED037A); refer to SOP No. 3, Section 2.2.1, for identification code.

(5) Geographic description of core location (e.g., Eastern Shore near Diamond Site).

(6) Wind speed and direction at time of core collection (e.g., 10-15 mph from NW).

(7) Air temperature at time of grab sample collection (e.g., 68ºF).

(8) Precipitation at time of grab sample collection (e.g., light rain).

(9) Cloud cover at time of grab sample collection (e.g., partly cloudy).

(10) Sea state at time of grab sample collection (e.g., 0-1 foot waves).

(11) Target Northing coordinate in feet from Table 4-4 or Table 4-5 of SRIWP.

(12) Target Easting coordinate in feet from Table 4-4 or Table 4-5 of SRIWP.

(13) Final Position Northing coordinate in feet.

(14) Final Position Easting coordinate in feet.

(15) Confirm the final position location is within 10 feet of the target location (refer to SOP No. 4).

(16) Final Northing coordinate of grab sample location in feet. This location may be different than (13) due to the adjustment of vessel position for multiple grab sample attempts at the same location (refer to SOP No.4).

(17) Final Easting coordinate of grab sample location in feet. This location may be different than (14) due to the adjustment of vessel position for multiple grab sample attempts at the same location (refer to SOP No. 4).

GRAB SAMPLE COLLECTION FORM KEY
(Sheet 2 of 2)

(18) Confirm the final location is within 50 feet of the target location; refer to SOP No. 4

(19) Water depth at grab sample collection in feet.

(20) Time of grab sample collection in EST.

(21) Indicate whether sufficient sediment was obtained to fill the sample container.

(22) Provide notes pertinent to grab sample collection (e.g., aborted grab sample collection due to weather); additional details may be provided in logbook.

(23) Sample ID (e.g., HRSRSED037A-01); refer to SOP No. 3, Section 2.2.1, for sample identification code.

(24) Date sample was collected (e.g., 1/1/2009).

(25) Time sample was collected in EST.

(26) Name of person entering information into this form.

CORE LITHOLOGY/DESCRIPTION FORM
(Sheet 1 of 2)

Date of Core Collection: _____(1)_____(from Individual Core Collection Form)

Date of Core Processing: _____(2)_____

Core ID: _____(3)_____(from Individual Core Collection Form)

Geographic Description: _____(4)_____(from Individual Core Collection Form)

Coordinate Northing (ft, NAD83): _____(5)_____(from Individual Core Collection Form)

Coordinate Easting (ft, NAD83): _____(6)_____(from Individual Core Collection Form)

Name of Person Responsible for Log: ____(7)_____

CORE LITHOLOGY/DESCRIPTION FORM
(Sheet 2 of 2)

Date of Core Collection: (1) Date of Core Processing: (2)
Core ID: (3)

Breathing Zone Action Levels:
For total hydrocarbon levels >5 ppm, upgrade to Level C PPE.
For total hydrocarbon levels >25 ppm, stop work.
For hydrogen sulfide levels >5 ppm, stop work, evacuate work area, and ventilate.

Depth (Feet Below Sediment Surface in Core)	PID Screening (ppm)	pH	ORP	Description	Engineer's/Geologist's Notes
(8)	(9)	(10)	(11)	(12)	(13)
-1 - -2 - -3 - -4 - -5 - -6 - -7 - -8 - -9 - -10 - -11 - -12					

CORE LITHOLOGY/DESCRIPTION FORM KEY
(Sheet 1 of 1)

DESCRIPTION OF ITEMS:

(1) Date of core collection (taken from the Individual Core Collection Form).

(2) Date of core processing (e.g., 1/1/2009).

(3) Core ID (e.g., HRSRSED030B) (taken from the Individual Core Collection Form).

(4) Geographic description of core location (e.g., Eastern Shore near Diamond Site) (taken from the Individual Core Collection Form).

(5) Northing coordinate in feet of core collection location (taken from the Individual Core Collection Form).

(6) Easting coordinate in feet of core collection location (taken from the Individual Core Collection Form).

(7) Name of person entering information into this form.

(8) Depth (feet below the sediment surface) of change in lithology and USCS description identified during logging. The procedures on how to describe the sediment core are provided in SOP No. 8.

(9) PID reading in ppm for the breathing zone above the interval screened (e.g., 6 ppm); action levels from Section 6.1 of HASP.

(10) pH reading in standard units from pH/ORP electrode.

(11) ORP reading in millivolts from pH/ORP electrode.

(12) Description of soil type using the USCS. The procedure of how to describe the sediment core is provided in SOP No. 8.

(13) Provide notes pertinent to the sample description (e.g., 1" gap observed in this interval) for a given lithological interval.

SAMPLE PROCESSING FORM
(Sheet 1 of 3)

Date of Sample Collection: (1)

Date of Sample Processing: (2)

Sample ID: (3)

Geographic Description: (4)

Primary Core: (5)

Coordinate Northing (ft, NAD83): (6) (from Individual Core Collection Form)

Coordinate Easting (ft, NAD83): (7) (from Individual Core Collection Form)

Actual Penetration (ft): (8) (from Individual Core Collection Form)

Recovery (ft) During Core Collection: (9) (from Individual Core Collection Form)

Recovery (%) During Core Collection: (10) (from Individual Core Collection Form)

Recovery (ft) During Core Processing: (11)

Recovery (%) During Core Processing: (12)

$$\text{Recovery (\%) During Core Processing} = \frac{\text{Recovery (ft) During Core Processing - Gaps (ft)}}{\text{Actual Penetration (ft)}} \times 100$$

SAMPLE PROCESSING FORM
(Sheet 2 of 3)

BAZ Core: (13)

Coordinate Northing (ft, NAD83): (14) (from Individual Core Collection Form)

Coordinate Easting (ft, NAD83): (15) (from Individual Core Collection Form)

Actual Penetration (ft): (16) (from Individual Core Collection Form)

Recovery (ft) During Core Collection: (17) (from Individual Core Collection Form)

Recovery (%) During Core Collection: (18) (from Individual Core Collection Form)

Recovery (ft) During Core Processing: (19)

Recovery (%) During Core Processing: (20)

$$\text{Recovery (\%) During Core Processing} = \frac{\text{Recovery (ft) During Core Processing} - \text{Gaps (ft)}}{\text{Actual Penetration (ft)}} \times 100$$

Name of Person Responsible for Log: (21)

SAMPLE PROCESSING FORM
(Sheet 3 of 3)

Date of Collection: _____ (1)
Date of Processing: _____ (2)
Sample ID: _____ (3)

Sample ID (22)	Sample Time (EST) (23)	Sample Interval (ft) (24)		Volatile Organics	PCDDs/PCDFs	PCB Congeners and Homologues	Pesticides and Aroclor PCBs	Semivolatile Organics	Mercury	Hexavalent Chromium	TAL Metals	Chlorinated Herbicides	Cyanide	TEPH	TOC	Percent Moisture	Grain Size	pH	ORP	Comments (26)
		Top	Bottom																	

SAMPLE PROCESSING FORM KEY
(Sheet 1 of 2)

DESCRIPTION OF ITEMS:

(1) Date of sample collection.

(2) Date of sample processing (e.g., 1/1/2009).

(3) Sample ID (e.g., HRSRSED030B)

(4) Geographic description of the sample location (e.g., Eastern Shore near Diamond Site).

(5) The primary core is the core containing all sample depths.

(6) Northing coordinate in feet of core collection location (taken from Individual Core Collection Form).

(7) Easting coordinate in feet of core collection location (taken from Individual Core Collection Form).

(8) Actual penetration of core into sediment (taken from the Individual Core Collection Form).

(9) Recovery (ft) at time of core collection = sediment length in core at the time of core collection (taken from the Individual Core Collection Form).

(10) Recovery (%) at time of core collection = sediment length at the time of core collection in core per actual penetration (taken from the Individual Core Collection Form).

(11) Recovery (ft) at time of core processing = sediment length in core at the time of processing. Note: the length of sediment in the core and the recovery may be different than listed on the Individual Core Collection Form due to additional consolidation of sediments within the core between the time cored and time processed.

(12) Recovery (%) during core processing = sediment length at the time of processing per actual penetration.

(13) The BAZ core is the core collected for the purpose of providing additional sample volume for the 0-0.5-foot BAZ sediment sample.

(14) Northing coordinate in feet of core collection location (taken from Individual Core Collection Form).

(15) Easting coordinate in feet of core collection location (taken from Individual Core Collection Form).

SAMPLE PROCESSING FORM KEY
(Sheet 2 of 2)

(16) Actual penetration of core into sediment (taken from the Individual Core Collection Form).

(17) Recovery (ft) at time of core collection = sediment length in core at the time of core collection (taken from the Individual Core Collection Form).

(18) Recovery (%) at time of core collection = sediment length at the time of core collection in core per actual penetration (taken from the Individual Core Collection Form).

(19) Recovery (ft) at time of core processing = sediment length in core at the time of processing.

(20) Recovery (%) at time of core processing = sediment length at the time of processing per penetration.

(21) Name of person entering information into this form.

(22) Sample ID (e.g., HRSRSED030B-02); refer to SOP No. 3, Section 2.2.1, for sample identification code.

(23) Time sample was removed from core in EST.

(24) Sample interval = target sample interval depths multiplied by Recovery (%) at time of core processing. For example, if target sample interval is 0.5 - 1.5 feet and the Recovery (%) at time of core processing is 80%, then the sample interval would be 0.4 - 1.2 feet.

(25) Check the boxes for which analyses the sample is being submitted.

(26) Provide any pertinent comments regarding the sediment sample submitted for analyses (e.g., not enough sample volume; therefore, TEPH and TOC not requested for analysis).

Fish Data Form

CHECKLIST FOR PHYSICAL EXAMINATION OF FISHES			
Date Collected:	Date Examined:	Sampling Method:	Fish No.:
Location:	Station No.:		Length (mm):
Examiner(s):	Species:		Weight (g):
			Sex:
Weather Conditions (deployment:):		Tide height (deployment):	
Weather Conditions (collection):		Tide height (collection):	
Tissue Samples	Frozen for analysis (Y/N):	Analytical Sample No:	
	Fixed for Pathology (Y/N):	Fixative:	

Fish Pathology Form

EXTERNAL PHYSICAL EXAMINATION					
BODY FORM		ISTHMUS		BRONCHIAL CAVITY	
	Normal		Normal		Normal
	Emaciated		Enlarged		Growths
	Truncate		Hemorrhagic		Parasites
	Scoliosis	EYES		UROGENITAL OPENING	
	Lordosis		Normal		Normal
BODY SURFACE			Popeye		Inflamed
	Normal		Cloudy cornea	ANUS	
	Raised scales		Missing		Normal
	Swollen		Lens deformed		Inflamed
	Lesions		Lens parasites	LESIONS - Location(s)	
	Excess mucous		Lens cataract		Fins
	Reoriented scales	FINS			Head
	Growths		Normal		Eyes
	Parasites		Frayed - eroded		Mouth
	Wounds		Parasites		Peduncle
	Wounds - lamprey		Hemorrhagic		Ventral
LIPS AND JAWS			Gas Bubbles		Dorsal
	Normal	FINS - ERODED			Lateral
	Deformed		Dorsal		

EXTERNAL PHYSICAL EXAMINATION					
LIPS AND JAWS		FINS - ERODED			
	Growths		Pectoral		
SNOUT			Pelvic		
	Normal		Anal		
	Pugnose (Pughead)		Adipose		
	Growths		Caudal		
	Abrasions				
BARBELS		GILLS		BEHAVIOR	
	Normal		Normal		Gasping
	Deformed		Bright red		Flashing
	Missing		Brown		Lethargic
OPERCLE			Gas bubbles		Fin twitching
	Normal		Parasites		Convulsions
	Incomplete	PSEUDOBRANCH			Headup-taildown
			Normal		Head-tail whirling
			Enlarged		Pectoral fins folded forward
					Belly up
					Loss of balance
					Long axis whirling
OTHER OBSERVATIONS					

BLUE CRAB DATA FORM

Project Number:_____ Sampling Date and Time:_____

SITE LOCATION

Site Name/Number:_____

County/Parish:_____ Lat./Long.:_____

Waterbody Name/Segment Number:_____

Waterbody Type: ☐ River ☐ Lake ☐ Estuary

Site Description:_____

_____

Collection Method:_____

Collector Name (print and sign):_____

Agency:_____ Phone:_____

Address:_____

SHELLFISH COLLECTED

Species Name:_____ Replicate Number:_____

Composite Sample #:_____ Number of Individuals:_____

Shellfish #	Size (mm)	Sex	Shellfish #	Size (mm)	Sex	Shellfish #	Size (mm)	Sex
001			018			035		
002			019			036		
003			020			037		
004			021			038		
005			022			039		
006			023			040		
007			024			041		
008			025			042		
009			026			043		
010			027			044		
011			028			045		
012			029			046		
013			030			047		
014			031			048		
015			032			049		
016			033			050		
017			034					

$\frac{\text{Minimum Size}}{\text{Maximum Size}}$ X 100 = _____ ≥ 75% Composite Mean Size:_____(mm)

Notes (e.g. morphological anomolies):

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Standard Operating Procedure No. 2

Decontamination

January 2009

Revision 0

1. Purpose and Scope

This Standard Operating Procedure (SOP) describes equipment, field procedures, and documentation procedures necessary to properly decontaminate equipment and instruments used during the conduct of the Supplemental Remedial Investigation Sampling Program for the Hackensack River Study Area (HRSA). Decontamination is the process of neutralization, washing, and rinsing exposed outer surfaces of equipment to minimize the potential for contaminant migration, and/or cross-contamination. This procedure does not apply to personnel decontamination, which is described in the Health and Safety Plan (HASP).

The overall objective of multimedia sampling programs is to obtain samples that accurately depict the chemical and physical conditions at the sampling site. Extraneous contaminated materials can be brought to a sampling location and/or introduced into the medium of interest during the sampling program from equipment that was previously used at another sampling site. Trace quantities of these materials can introduce indigenous concentrations into other samples and lead to false positive analytical results and, ultimately, to an incorrect assessment of the conditions associated with a site. Decontamination of sampling equipment (e.g., water and sediment samplers, containers, and other equipment) and field support equipment (e.g., sampling vessel) is required so that sampling cross-contamination is prevented, and on-site contaminants are not carried away from the HRSA.

2. Procedures

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all materials on the equipment list may be required for each sampling investigation conducted under this sampling program.

- bristle brushes
- wash/rinse tubs
- low phosphate detergent
- 10 percent nitric acid, ultrapure
- acetone, methanol, and hexane (pesticide grade or better in separate Teflon® bottles)

- distilled/deionized (analyte-free) water
- stainless steel bowls
- aluminum foil
- tap water (from any treated municipal water supply)
- high-pressure/steam cleaner
- appropriate health and safety equipment (as required by the HASP)
- sample container(s) for rinsate blank, if collected
- field logbook

2.2 Sampling Equipment Decontamination

Any sampling apparatus that comes into contact with sample matrices will be decontaminated prior to use in the field to minimize cross-contamination of samples. While performing the decontamination procedure, "phthalate-free gloves," such as nitrile or butyl rubber, must be used in order to prevent phthalate contamination of the sampling equipment or the samples. Sampling equipment will be decontaminated in the area designated for decontamination.

The decontamination procedure followed by U.S. Environmental Protection Agency (USEPA) Region 2 (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Quality Assurance Manual; USEPA 1989) will be used **prior to each sampling event for sampling equipment that will come into contact with the media to be sampled**. The USEPA Region 2 procedures are summarized below:

1. Wash and scrub with low phosphate detergent.
2. Rinse with tap water.
3. Rinse with 10 percent nitric acid, ultrapure.
4. Rinse with deionized “analyte-free” water.
5. Spray or rinse with acetone only or a methanol followed by hexane spray or rinse (solvents must be pesticide grade or better).

6. Rinse thoroughly with deionized ("analyte-free") water.

7. Air dry.

8. Wrap in aluminum foil, shiny side out, for temporary storage and transport.

Sampling equipment being used to collect samples for polychlorodibenzodioxins/ polychlorodibenzofurans analysis will be rinsed with methanol followed by hexane, not just acetone. High-performance liquid chromatography- grade water will be used for the final deionized (analyte-free) water rinse. If samples are collected for geotechnical laboratory testing only (e.g., grain size), the sampling equipment will be rinsed after washing only with tap water mixed with a low-phosphate detergent solution.

Solvents used during decontamination activities will be collected and handled in accordance with residuals management as outlined in SOP No. 13 - Management and Disposal of Residuals.

Not all sampling equipment will require the full decontamination procedures listed in the USEPA Region 2 CERCLA Quality Assurance Manual. The sediment sampler, tissue homogenizer, and other tissue preparation equipment will undergo decontamination as specified by USEPA Region 2.

The following steps will be used to decontaminate boat anchors, lines, ropes, submersible pump and hose, gill nets, minnow traps, crab pots, buoys, and buoy marker weights:

1. Personnel will dress in suitable personnel protective equipment to reduce personal exposure (see the HASP).

2. Equipment will be rinsed with river water.

3. Rinse water will not be contained.

2.3 Field Instruments and Equipment

Instrumentation should be cleaned as per the manufacturer's instructions. Probes, such as those used in dissolved oxygen, temperature, pH, salinity, and conductivity meters, will be carefully wiped clean using a sponge and detergent water and rinsed with deionized water. Care will be taken to prevent damage to equipment. When possible, those instruments that are difficult to decontaminate, such as cameras and logging instruments, may be protectively wrapped to reduce or eliminate the need for decontamination.

2.4 Rinsate Blanks

Rinsate blanks are a type of quality assurance/quality control sample collected to assess the adequacy of decontamination procedures. Rinsate blanks are collected by pouring deionized, analyte-free water or solvent, whichever is appropriate, to the contaminants of interest, (i.e., solvent used in the equipment decontamination process) over the sampling equipment (e.g., sampler, knife, bowl, pan, or blender) after it has been decontaminated in the field. The rinsate is collected in a stainless steel bowl and transferred to sample bottles for analysis with other samples. Rinsate blanks will be collected at the frequency specified in the SRIWP.

3. Documentation

Field personnel are responsible for documenting decontamination activities related to their on-site activities (refer to SOP No.1 – Field Documentation). Observations and data will be recorded with ink in a field logbook with consecutively numbered pages. The information in the field logbook will include the following (at a minimum):

- responsible person's name
- date and time of activity
- information concerning items decontaminated and the procedure utilized
- information related to the collection of rinsate blank samples

4. References

USEPA. 1989. Comprehensive Environmental Response, Compensation, and Liability Act Quality Assurance Manual, Revision 1. October.

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Standard Operating Procedure No. 3

Containers, Preservation, Handling, and Tracking of Samples for Analysis

January 2009

Revision 0

SDG Tracking Log

Custody Seal

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for containerizing, preserving, handling, tracking, and shipping samples collected as part of the Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP). Samples may include sediment collected or generated for chemical analysis and associated quality assurance (QA) analysis.

This SOP is intended to be complete enough so that 1) the steps which could affect tracking, documentation, or integrity of samples are explained in sufficient detail and 2) different sampling personnel following these procedures will deliver samples to the laboratory, which are equally reliable and consistent and in compliance with regulatory agency requirements. Specific information regarding sample collection and analysis is found in the SRIWP.

This SOP may change depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Facility Coordinator and the New Jersey Department of Environmental Protection Site Manager. The ultimate procedure employed will be documented in the HRSA Supplemental Remedial Investigation (RI) Report.

Other SOPs will be utilized with this procedure, including:

- SOP No. 1 – Field Documentation
- SOP No. 6 – Sediment Collection Using Hand Coring Device
- SOP No. 7 – Sediment Collection Using Vibracoring Device
- SOP No. 8 – Core Processing
- SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests
- SOP No. 10 – Benthic Invertebrate Community Sampling
- SOP No. 11 – Fish Tissue Sampling
- SOP No. 12 – Crab Tissue Sampling
- SOP No. 13 – Management and Disposal of Residuals

2. Procedures

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment and other safety equipment, as required in the project SRIWP
- inert packing material (e.g., foam peanuts, vermiculite, cardboard, etc.)
- colorimetric pH test paper
- nitric acid ($HNO_{3)}$ and pipette
- sample containers, as specified in Tables 4-8 and 4-9 of the SRIWP
- sample labels
- chain of custody
- sample delivery group (SDG) tracking logs
- ice chest(s)
- custody seals
- indelible marking pens
- shipping tape
- sealable plastic bags
- temperature blanks (if not provided by the laboratory)
- logbook
- ice or similar chilling source
- potassium iodide starch paper

- spatula
- sodium hydroxide (NaOH) and pipette
- plastic lining material
- clear tape
- 10 percent solution of buffered formalin or equivalent

2.2 Sample Identification and Labeling

2.2.1 Sample Identification Code

The standard sample identification number will consist of a unique 13-character string used to identify each sample that is collected and submitted to the laboratories for analysis, as follows:

Characters 1 and 2:	Two characters to describe the water body where the sample was collected. For this sampling program, this will be “HR” for Hackensack River.
Characters 3 and 4:	Two characters to describe the sampling program. For example, the program will be described as “SR” for Supplemental RI.
Characters 5, 6, and 7:	Three characters to describe the sample matrix. For this program, this will be “SED” for sediment or “TIS” for tissue.
Characters 8, 9, and 10:	A three-digit number to describe the sample collection location (sequentially numbered from 001 to 999).
Character 11:	A character that describes the sequence of cores or grabs collected at this location (A, B, C, etc.).
Characters 12 and 13:	A two-digit number (preceded by a hyphen) to describe the sample collected at the location, sequentially numbered from 01 through 99, beginning at the top of the core and proceeding down to the bottom of the core.

Field duplicates will be identified using the first seven digits described above (e.g., HRSRSED), followed by the letters "DUP" to indicate the sample is a duplicate, and then followed by a three-digit number to describe the duplicate number. Duplicates will be numbered sequentially as they are collected. For example, HRSRSEDDUP001 would indicate that the sample is the first sediment duplicate collected for the program.

Location Identifier

Location IDs are pre-assigned and are found in Tables 4-4 through 4-6 of the SRIWP. The location ID and location information (coordinates) will be recorded on the Individual Core Collection Form, the Core Lithology/Description Form, the Grab Sample Collection Form, Tissue Collection Forms, and the Sample Processing Form (SOP No. 1 – Field Documentation).

Sample Identifier

The sample identifier is represented by characters 12 and 13. For sediment samples collected from cores, the first interval to be sampled for chemical analyses (starting from the top of the core) will be assigned a sample number 01, and each subsequent interval sampled (with increasing depth) will be assigned the next higher sequential sample number (i.e., 02, 03, etc.)

Following is an example of a sediment core segment identification code:

HRSRSED030B-02

Explanations:

- The sample was collected in the Hackensack River as part of the Supplemental RI Program and was a sediment sample.
- The sample was collected at Location 30 from the second core at that location.
- The sample represents the second interval sampled for analysis, referenced to the top of the core.

2.2.2 Sample Delivery Group Number Identification Code

The standard SDG Number will consist of a unique six-character string used to identify each SDG submitted to the laboratories for analysis, as follows:

Characters 1 and 2:	Two characters to describe the water body where the samples were collected. For this program, this will be "HR" for Hackensack River.
Characters 3 and 4:	Two characters to describe the sampling program. For example, the program will be described as "SR" for Supplemental RI.
Characters 5 through 7:	A three-digit number to describe the SDG, sequentially numbered from 001 through 999.

Following is an example of a SDG Number:

HRSR003

Explanations:

The samples in this SDG were collected from the Hackensack River during the Supplemental RI Program. The SDG was the third SDG submitted to the laboratory for analysis.

2.2.3 Quality Assurance Sample Identification Code

Rinsate Blank Samples

Rinsate blank samples will be labeled by a unique eight-character string. The first six characters will be the SDG Number that the rinsate blank is being submitted with. The last two characters will be "RB" for rinsate blank.

Following is an example of a rinse blank sample identification number:

HRSR003RB

Explanation:

This rinsate blank was submitted along with samples collected from the Hackensack River during the Supplemental RI Program with the third SDG.

Trip Blank Samples

Trip blank samples will be labeled by a unique eight-character string. The first six characters will be the SDG Number that the trip blank is being submitted with. The last two characters will be “TB” for trip blank.

The following is an example of a trip blank sample identification number:

HRSR003TB

Explanation:

This trip blank was submitted along with samples collected from the Hackensack River during the Supplemental RI Program with the third SDG.

2.2.4 Sample Labeling

A label will be attached to each bottle used for sampling. An example of a pre-printed sample label is attached to this SOP. When practical, the project number, sample matrix, laboratory designation, and sample identification code will be typed or printed onto the label before sampling. Once affixed to the sample container, the label will be protected from water and solvents with clear packing tape.

2.3 Sample Containers and Preservation

2.3.1 Sample Containers

To ensure that the appropriate sample quantities are collected in certified, pre-cleaned containers, sample containers for this project will be supplied from commercial suppliers or laboratories. Sample containers will be cleaned to the quality control standard defined in the U.S. Environmental Protection Agency (USEPA) Office of Solid Waste and Emergency Response (OSWER) Directive #9240.0-05A. Certification of sample container quality per the OSWER directive will be kept in the Hackensack River Central Project File. Tables 4-8 and 4-9 of the SRIWP summarize container types that will be provided for samples collected.

2.3.2 Sample Preservation

The contracted laboratory performing the analysis will provide certified, pre-cleaned containers containing a pre-determined amount of the required preservative(s) for rinsate blanks, as appropriate. In cases where field adjustment of pH is necessary, the procedures outlined below will be followed for the appropriate analysis. Sample

containers for sediment chemical analysis and toxicity will not contain preservatives. Sediment samples for benthic community analysis will require a 10 percent solution of buffered formalin or equivalent.

The rinsate blank sample containers will be pre-preserved by the laboratory. The specific preservatives to be used for each chemical analysis are summarized in Tables 4-8 and 4-9 of the SRIWP. Documentation of equipment and methods used in preservation, and field-adjustment of pH will be maintained in a logbook. The chemicals and amounts used will be recorded. If refrigeration is necessary, samples will be placed on ice after collection, and shipping containers will be packed with additional ice, if needed, prior to shipment via overnight carrier.

2.3.2.1 pH for Rinsate Blanks for Cyanide Analysis

Aqueous rinsate blank sample bottles for cyanide analysis will be pre-preserved with NaOH. Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is less than 12, increase the pH of the rinsate blank by adding 50 percent NaOH. Using a pipette, add 0.2 ml (4 to 5 drops) of NaOH to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (greater than 12) is achieved. The aliquots used for testing the pH will be disposed of in accordance with SOP No. 13 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

2.3.2.2 pH for Rinsate Blanks for Metals Analysis

Aqueous rinsate blank sample bottles for metals analysis will be preserved with HNO3. Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is greater than 2, lower the pH of the rinsate blank by adding HNO3. Using a pipette, add 0.2 ml (4 to 5 drops) of HNO3 to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (less than 2) is achieved.

The separate aliquots used for testing the pH will be disposed of in accordance with SOP No. 13 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

2.3.2.3 pH for Rinsate Blanks for Total Organic Carbon Analysis

Aqueous rinsate blank sample bottles for total organic carbon analysis will be preserved with sulfuric acid (H_2SO_4). Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is greater than 2, lower the pH of the rinsate blank

by adding H2SO4. Using a pipette, add 0.2 ml (4 to 5 drops) of H2SO4 to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (less than 2) is achieved.

The separate aliquots used for testing the pH will be disposed of in accordance with SOP No. 13 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

2.3.2.4 pH for Rinsate Blanks for Total Extractable Petroleum Hydrocarbon Analysis

Aqueous rinsate blank sample bottles for total extractable petroleum hydrocarbon analysis will be preserved with hydrogen chloride (HCl). Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is greater than 2, lower the pH of the rinsate blank by adding HCl. Using a pipette, add 0.2 ml (4 to 5 drops) of HCl to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (less than 2) is achieved.

The separate aliquots used for testing the pH will be disposed of in accordance with SOP No. 13 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

2.3.2.5 pH for Rinsate Blanks for Volatile Organic Compound Analysis

Aqueous rinsate blank sample bottles for volatile organic compound (VOC) analysis will be pre-preserved with sufficient HCl to lower the rinsate blank below a pH of 2. Rinsate blanks for VOC analyses will be prepared using the following procedure:

1. Slowly pour rinsate blank into pre-prepared VOC vial until a meniscus is formed on the top of the vial.

2. Carefully cap the VOC vial and gently invert the vial to check for air bubbles.

3. Repeat process until no air bubbles are present. Dispose of VOC samples with air bubbles in accordance with SOP No. 13 – Management and Disposal of Residuals.

2.4 Sample Handling and Shipping

Sample packaging and shipping will be done in accordance with applicable regulations, as described below.

After filling a sediment sample container, affix cap and securely seal with clear tape (except for samples to be analyzed for VOCs), and complete the sample label. Apply the label to the sample container and cover with clear tape. Clean the outside of each sample container by wiping it off with a clean paper towel. Verify that residual sediment has been removed from the outside of the container, and from the area under and around the cap. Seal each sample container inside a sealable plastic bag. Samples for VOC analysis will be packaged together in a sealed plastic bag.

For tissue samples, wrap in aluminum foil, shiny side out and wrap in sealed, labeled plastic bag.

Place samples on ice or similar chilling source immediately after collection.

Transfer the samples to a plastic-lined ice chest, which will be used as a shipping container. Use inert packaging material (e.g., cardboard, vermiculite, etc.) to cushion the samples and minimize the potential for breakage. Seal the drains on the ice chest (if present) with shipping tape or plug the drains with silicone sealant or a similar inert substance.

Ice chests will contain ice or similar chilling sources sufficient to maintain a temperature of 4° Celsius inside the cooler during transport, as necessary. Use sufficient ice to accommodate reasonable delays in shipment. A temperature blank

provided by the analytical laboratory with each cooler will be included in the shipment. [Note: Samples submitted for grain size and benthic community analyses do not need to be shipped on ice.]

Complete sample tracking documentation as described in Section 2.5 of this SOP, and place the documents in a sealable plastic bag inside the ice chest, taped to the inside of the lid. Prior to sealing for shipment, check the list of samples against the container contents to verify the presence of each sample listed on the chain of custody.

Secure chest lid with shipping tape by covering the entire seal with tape. Complete information on the custody seal and affix the custody seal over the taped seal.

Transport the shipping container directly to the laboratory, the laboratory courier, or to the overnight carrier for overnight delivery. Once a core has been opened, sediment samples will be shipped by close of business the following day. Rinsate blank samples will also be shipped by close of business the following day with the appropriate SDG. Trip blank samples will be shipped in the cooler(s) with VOC samples.

2.5 Sample Tracking

From the time of collection through transportation, the handling of samples will follow chain-of-custody procedures. Completed and signed Individual Core Collection Forms, Grab Sample Forms, and Fish or Blue Crab Data Forms will be provided by the samplers to the Sample Processing Area personnel when relinquishing the sampled material (e.g., cores, grabs, tissue samples) for sample processing. The Sample Processing Area personnel will sign the forms, thus accepting custody of the samples.

A sample is considered under the sampler's custody if one or more of the following criteria are met:

- sample is in the sampler's possession
- sample is in the sampler's view after being in sampler's possession
- sample was in the sampler's possession and then locked up to prevent tampering
- sample is in a designated secure area

Samples collected for analysis will be continuously tracked in the Sample Processing Area and while in transit to the laboratory by use of the procedures discussed below. The Sample Processing Area will be secured (locked) with limited access.

Individual sample bottles will be properly labeled and securely sealed before being placed in the container for shipment to the laboratory.

Pertinent information will be entered on the Chain-of-Custody Form in the field (see attached Chain-of-Custody Form and Form Key). Assignment of the SDG Number, the matrix spike/matrix spike duplicate (MS/MSD) assignments, and the analyses requested for each sample will be made on both the SDG Tracking Log (attached to this SOP) and the Chain-of-Custody Form.

The Chain-of-Custody Form must include the following, as required by guidance in SW-846, Test Methods for Evaluating Solid Waste (USEPA 1993): 1) project name; 2) signatures of samplers; 3) sample number, date and time of collection, and grab or composite sample designation; 4) signatures of individuals involved in sample transfer; and 5) if applicable, the air bill or other shipping number.

The completed Chain-of-Custody Form will be signed, dated, enclosed in a sealable plastic bag with a copy of the SDG Tracking Log, and placed in the container prior to shipment. A copy of both documents will be retained by field personnel and stored in a dedicated binder. Additional copies will be distributed as follows:

- A copy will be faxed to the Lead Consultant PM or designee.
- A copy will be faxed to the data validator.
- A copy will be faxed to the lab manager/client service representative at each laboratory being used.

Samples will be considered in the sampler's custody while in his/her possession or within sight, or locked in a secure area prior to shipment. If the person packing the container and verifying the sample list is different than the sampler, both the sampler and the packer will sign the Chain-of-Custody Form.

Upon receipt at the laboratory, the designated laboratory sample custodian will sign the Chain-of-Custody Form indicating receipt of the incoming field samples. The samples will be checked against the Chain-of-Custody Form upon arrival at the laboratory. The receiving personnel will enter all arriving samples into a laboratory logbook. Any discrepancies between the samples and the chain-of-custody form(s), or any evidence of tampering with the shipping container or the custody seal will be immediately reported to the Lead Consultant PM. The sample custodian will immediately check the temperature of the cooler upon arrival at the laboratory and record the measured temperature on the Chain-of-Custody Form and in a laboratory logbook.

A copy of the Chain-of-Custody form will be distributed to the following individuals on the day of sample receipt:

- A copy will be faxed to the Lead Consultant PM or designee.
- A copy will be faxed to the data validator.
- A copy will be faxed to the field office.

The original will be retained by the laboratory's sample custodian.

3. Documentation

3.1 Field Notes

Documentation of sample handling activities will be conducted in accordance with SOP No. 1 – Field Documentation. The following information should also be included in the logbook (at a minimum):

- sample IDs collected on that day
- brief synopsis of types of equipment and methods used in collecting the samples
- details regarding the field adjustment of preservatives, if necessary

3.2 Chain-of-Custody Documentation

Samples will be tracked through chain-of-custody documentation as described in Section 2.5 of this procedure.

4. References

U.S. Environmental Protection Agency. 1993. SW-846, Test Methods for Evaluating Solid Waste, Third Ed., including Promulgated Update I, Chapter One.

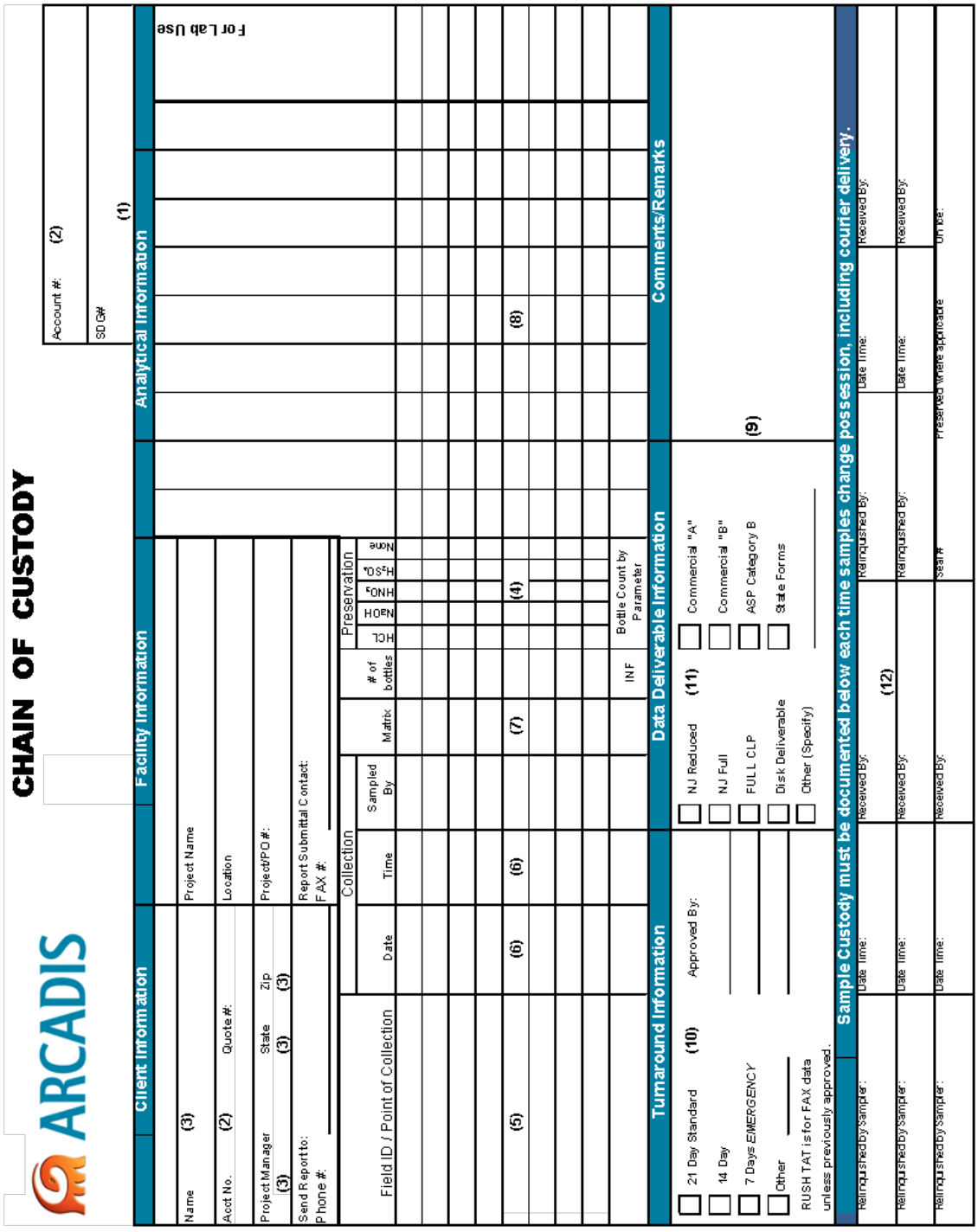
PRE-PRINTED SAMPLE LABEL

	PROJECT #: (1) PROJECT NAME: Hackensack River Supplemental RI Program
SDG #: (2)	
SAMPLE #: (3)	DATE SAMPLE COLLECTED: (4)
TIME SAMPLE COLLECTED: (5)	
LABORATORY: (6)	
SAMPLE MATRIX: (7)	
ANALYSES REQUIRED: (8)	
PRESERVATIVE: (9)	
SAMPLER: (10)	
REMARKS: (11)	

Key:

(1) Company-specific project number, if appropriate
(2) SDG Number
(3) Sample Number (e.g., HRSRSED030B-02)
(4) Date sample was collected from the core (e.g., 1/1/2009)
(5) Time sample was collected (Eastern Standard Time [EST])
(6) Laboratory used for analyses
(7) Sample matrix type (e.g., water, sediment, tissue)
(8) Analyses required for sample
(9) Preservative(s) used on sample (pre-preserved by the laboratory)
(10) Sampler name
(11) Remarks pertinent to proposed analyses

CHAIN-OF-CUSTODY FORM



CHAIN-OF-CUSTODY FORM KEY

(1) SDG Number (as described in Section 2.2.2 of this SOP) (e.g., HRSR003).

(2) Analytical laboratory's internal work order number (to be completed by analytical laboratory).

(3) Laboratory, project manager, state, and zip code where the samples are to be sent.

(4) Preservation methods and bottles.

(5) Sample ID (e.g., HRSRSED03B-03); refer to Section 2.2 of this SOP for sample and QA sample IDs.

(6) Date and time (EST) of sample collection.

(7) Sample matrix (e.g., sediment, water, tissue).

(8) Provide analysis and method for which sample is being submitted. Check the appropriate box for which analyses the sample is being submitted.

(9) Provide any pertinent comments regarding the sediment sample submitted for analyses (e.g., not enough sample volume for full analyses).

(10) Provide turnaround time information to the analytical laboratory.

(11) Provide data deliverable information to the analytical laboratory.

(12) Signatures for custody to be completed by sampler and analytical laboratory.

SDG TRACKING LOG

SDG Number _____(1)_____ **SDG Open Date** _____(3)_____

Sample Matrix _____(2)_____ **SDG Close Date** _____(4)_____

Sample #	Sample ID	MS/MSD	Comments
1	(5)	(6)	(7)
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Rinsate Blank	(8)	N/A	(9)
Trip blank	(10)	N/A	(11)

Notes:

1. The SDG must not exceed 20 field samples. Rinsate blanks do not count towards the sample total. Check which of the 20 samples have been collected to include extra volume for MS/MSD and assign as such.
2. 3x the weights listed should be collected for lab QC (i.e., MS/MSD/internal lab duplicate).
3. Field duplicate is a separate sample, not to be confused with “internal lab duplicate.”

SDG TRACKING LOG KEY

(1) SDG Number (as described in Section 2.2.2 of this SOP; e.g., HRSR003.

(2) Matrix of samples in this SDG (e.g., sediment, tissue).

(3) Date first sample in SDG is collected.

(4) Date last sample in SDG is collected (not to exceed 7 days beyond the open date entered in Line 3).

(5) Sample ID (e.g., HRSRSED030B-03).

(6) Check if a MS or MSD analysis should be performed on this sample. If a MS or MSD is to be performed, note in the "Comments" column which analysis the MS/MSD should be performed for. If the sample is not to be analyzed for a MS/MSD, then leave blank.

(7) Provide any pertinent comments regarding the samples submitted for analyses (e.g., "MS for Herbicide").

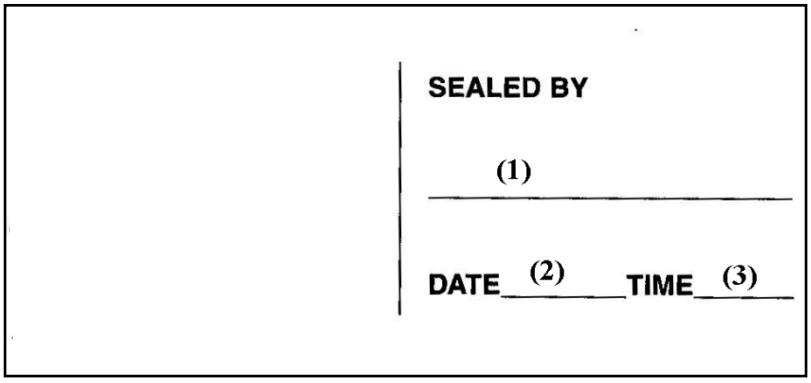
(8) Rinsate blank ID as described in Section 2.2.3 of this SOP (e.g., HRSR003RB).

(9) Provide any pertinent comments regarding the rinsate blank submitted for analyses.

(10) Trip blank ID as described in Section 2.2.3 of this SOP (e.g., HRSR003TB).

(11) Provide any pertinent comments regarding the trip blank submitted for analyses.

Custody Seal



Key:

(1) Name of individual sealing ice chest.

(2) Date ice chest is sealed.

(3) Time ice chest is sealed (EST).

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Standard Operating Procedure No. 4

Positioning

January 2009

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for positioning sampling/coring vessels for the Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP). Positioning will be conducted to locate the vessel(s) with sufficient accuracy and precision to meet project objectives during the sediment sampling activities.

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to position sampling vessels. Specific information regarding proposed sampling locations is provided in the SRIWP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Facility Coordinator and the New Jersey Department of Environmental Protection Site Manager. The ultimate procedure employed will be documented in the HRSA Supplemental Remedial Investigation Report.

Other SOPs will be utilized with this procedure, including:

- SOP No. 1 – Field Documentation
- SOP No. 6 – Sediment Collection Using Hand Coring Device
- SOP No. 7 – Sediment Collection Using Vibracoring Device
- SOP No. 9 – Surface Sediment Collection for Sediment Chemistry and Toxicity Tests
- SOP No. 14 – Tide Gage Installation

2. Procedures

Activities (e.g., coring, grab sampling, gill netting, trap deployment) will be conducted within the HRSA from a sampling vessel(s). In accordance with procedures outlined below, these vessels must be properly positioned and their position recorded before each activity can begin.

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- vessel(s) adequate for Hackensack River conditions
- 25-watt marine very high frequency (VHF) radio
- navigation charts (paper or digital) and the Proposed Sediment Sampling Locations figure (Figure 4-1 of the SRIWP)
- Real-Time Kinematic Differential Global Positioning System (DGPS) receivers (x2) with an accuracy of +1 foot
- DGPS external antennas (x2)
- equipment user manuals
- table of target sampling location coordinates
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices)
- logbook (paper or digital)
- Individual Core Collection Forms, Grab Sample Collection Forms, Fish Data Form/Pathology Form, and Blue Crab Data Forms (SOP No. 1 – Field Documentation)
- permanent marker or grease pencil.

2.2 Positioning Vessel

This section gives the step-by-step procedures for vessel positioning. Observations made during vessel positioning should be recorded on the Individual Core Collection and Grab Sample Collection Forms and/or logbook, as appropriate.

A DGPS will be used to establish locations during implementation of activities specified in the SRIWP. Two DGPS units will be required: one on board the vessel with a receiving antenna to be aligned with the deployment of the sampling apparatus, and the

other at a known fixed location (monument or temporary benchmark) to provide corrections to the standard GPS signal.

While this SOP provides general guidance and procedural steps, personnel performing positioning activities also should follow the appropriate sections of equipment user's manuals and have the manuals available for reference at all times.

The following procedures describe the steps to establish position at a location, as well as the steps to adjust the positioning for collection of additional cores and grab samples, as necessary.

2.2.1 Establishing Position at a Location

Preliminary Activities

1. For each of the planned locations for the day, obtain the appropriate form(s) (e.g., Individual Core Collection Form). Complete the Daily Activity Log provided in SOP No. 1 – Field Documentation.

2. For each of the planned locations for the day, obtain the target sampling locations. For Program activities, these locations have been selected prior to commencement of field activities, as described in the SRIWP, and as shown on Figure 4-1 and listed in Tables 4-4 through 4-6 of the SRIWP. The location of each target sampling location will be established in the New Jersey State Plane Coordinate System with respect to the North American Datum of 1983.

3. Enter coordinates for the locations into the DGPS unit that will be on board the vessel as a waypoint.

Field Activities

1. Establish a DGPS base station over a shore-based marker prior to sampling operations. The operation and horizontal/vertical accuracy of the vessel mounted DGPS will be verified at another shore-based marker by recording observed horizontal and vertical (XYZ) data and comparing these data to the published XYZ data for a given point. After initial DGPS system verification, a temporary benchmark may be established at a location convenient to the vessel to facilitate daily DGPS system performance verification.

2. Verify the receiving antenna is properly aligned with the sampling device (e.g., vibracorer or grab sampler).

3. Identify and approach actual sampling locations by using data from the DGPS unit in the navigation mode. The navigation mode provides information on heading, distance remaining, and time remaining. This information is based on the selected waypoint location and the present location of the vessel.

4. Anchor the vessel adjacent to the planned location, if desired.

5. Once the vessel is on location and secured, note the coordinates from the DGPS unit and check the coordinates to verify that the vessel is within the pre-determined range of the target location (i.e., 10 feet for coring or grab sampling). If the vessel is not at an acceptable location, adjust the vessel's location and recheck the position. Repeat this process until the vessel's position is within the acceptable range of the target. Record the final coordinates on the appropriate form.

6. Once the coordinates are acceptable, perform activity at the location. For this program, collect samples in accordance with the appropriate SOP (SOP No. 6 – Sediment Collection Using Hand Coring Device, SOP No. 7 – Sediment Collection Using Vibracoring Device, or SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests). The locations for collection of mummichog tissue samples will be identified within the mudflat grab sampling stations, and their position will be mapped using differential GPS.

7. Record final location coordinates on the appropriate form once the sampling device has penetrated the sediment to the target depth or refusal and prior to retrieval. Plot locations onto a master chart or use computer-based, real-time software to verify location.

8. At the end of the sampling day, check the data loaded onto the DGPS units to verify the existence of sampling locations where data were collected.

2.2.2 Adjusting Position during Activities

The following steps will be used to adjust position for on-water coring/sampling activities:

1. Move the vessel 10 feet from the initial sampling location and within a 50-foot radius of the target coordinates.

2. Check the coordinates to verify that the vessel is within 50 feet of the target coordinate and note this on the Individual Core Collection Form or Grab Sample Collection Form.

3. Once the coordinates are acceptable, collect samples in accordance with the appropriate SOP (SOP No. 6 – Sediment Collection Using Hand Coring Device, SOP No. 7 – Sediment Collection Using Vibracoring Device, or SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests). Record the final location on the Individual Core Collection Form or Grab Sample Collection Form.

4. Repeat Steps 1 through 3 until the appropriate number of samples is collected.

2.3 Calibration, Maintenance, and Use of Field Instruments

DGPS system performance will be verified as described in Section 2.2 of this SOP. Maintenance and use of DGPS units should follow the appropriate sections of the equipment user's manual. Field personnel will have the manual available for reference.

Despite virtually worldwide, 24-hour coverage, technical difficulties with GPS satellites can still occur. In the event of system-wide or other long-term problems with GPS (e.g., satellite failures), vessel positioning will be achieved using land-based methods. If a land-based method is selected, an SOP will be developed for its use.

3. Quality Assurance

For this program, quality assurance activities for positioning procedures include verification of grab sample or core location by comparing the target coordinates specified in Tables 4-4 through 4-6 of the SRIWP with coordinates entered into the DGPS, and by plotting the coordinates on a master chart.

4. Documentation

Detailed positioning data will be recorded on the Grab Sample Collection and Individual Core Collection Forms provided in SOP No. 1 – Field Documentation. In addition, the following information will be recorded in a logbook (at a minimum):

- notes on breaking position during sampling
- equipment calibration information
- summary of vessel activities

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Standard Operating Procedure No. 5

Habitat Characterization

January 2009

Revision 0

1. Purpose and Scope

This Standard Operating Procedure (SOP) defines the procedures to be followed for conducting a habitat characterization survey along the Hackensack River Study Area (HRSA) during implementation of the Supplemental Remedial Investigation Work Plan (SRIWP). These procedures describe the equipment and field methods that are necessary to define and characterize riverine and shoreline habitats within the HRSA, and to conduct a qualitative survey for semi- or non-aquatic biota.

2. Equipment List

Equipment to be used during the habit survey may include, but is not limited to the following:

- sampling vessel
- camera
- video camera
- avian checklists
- neutral or camouflage clothing
- field guides (i.e., plants, mammals, birds)
- maps of the Site
- National Oceanic and Atmospheric Administration navigation chart for the Hackensack River
- tide tables
- binoculars (6X, 7X, or 8X)
- zoom spotting scope with tripod
- waterproof marking pens
- logbook

3. Survey Procedures

An observational habitat characterization will be conducted during the sampling event, as described in the SRIWP. This survey will delineate beyond 100 feet of the shoreline and will consist of the following two components:

- quantification and characterization of the habitats that are present within the HRSA, including the river and its shoreline
- qualitative survey for semi- or non-aquatic organisms that may utilize the HRSA

The purpose of the habitat characterization is to define and characterize the available habitats in the HRSA. The following protocols will be followed, as practicable, for the habitat characterization.

1. The shorelines of the HRSA will be videotaped from the sampling vessel during both a low or near low tide period and a high or near high tide period. The date, start time, finish time, and tide of each video will be recorded in the logbook.

2. A photographic record of each shoreline will be constructed. Pictures of both shorelines will be taken from the sampling vessel at discrete intervals such that shoreline features (i.e. bulkheads, vegetation, mudflats, etc.) are clearly documented within each segment of the River. The location, date, tide, and time of each photograph will be recorded in the logbook.

3. Habitat areas identified during the survey will be photographed and located on a navigation chart. Habitats that are identified will be assigned a simple letter or numerical code that will be recorded directly on the navigation chart(s). For each code and where relevant, the approximate size and extent of the surveyed habitat, the predominant vegetative communities, and a description of the surrounding areas will be recorded in the field logbook.

4. Any semi- or non-aquatic birds and mammals observed during the survey will be identified; the date, time, and location of the observation will be recorded in the field logbook.

4. Documentation

The field personnel are responsible for documenting field activities related to the habitat characterization. Observations and data will be recorded with ink in a field logbook with consecutively numbered pages. The information in the field logbook will include the following (at a minimum):

- responsible person's name
- dates and times of activities
- list of all species observed
- location and description of all habitats observed
- information (i.e., date, time, location) regarding each photograph and video

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Standard Operating Procedure No. 6

Sediment Collection Using Hand Coring Device

January 2009

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for collecting cores using a hand coring device as part of the Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP).

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to collect cores. Specific information regarding core and sample collection and analysis can be found in the SRIWP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator and the New Jersey Department of Environmental Protection Site Manager. The ultimate procedure employed will be documented in the HRSA Supplemental Remedial Investigation Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Decontamination
- SOP No. 4 – Positioning
- SOP No. 8 – Core Processing
- SOP No. 13 – Management and Disposal of Residuals

2. Procedures

Cores may be collected within the HRSA using a hand coring device. Following collection, cores will be transported to the Sample Processing Area. Core processing procedures are described in SOP No. 8 – Core Processing.

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the SRIWP

- navigation charts and Proposed Sediment Sampling Locations (Figures 4-1 and 4-2 of the SRWIP)
- sampling vessel adequate for Hackensack River conditions
- marine very high frequency (VHF) radio
- positioning equipment
- decontaminated polycarbonate (or polybutyrate) coring tube with end caps
- decontaminated core driver
- decontaminated stainless steel core catcher
- hacksaw
- decontaminated hacksaw blades
- decontaminated drill bits
- drill
- Daily Activity Log and Individual Core Collection Form (SOP No. 1 – Field Documentation).
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices)
- logbook
- permanent marker or grease pencil
- fathometer (or lead line) with a resolution of 0.1 foot
- tape measure
- submersible pump and hose
- core storage rack to hold cores vertical and cold during temporary storage on board the coring vessel
- duct tape

- camera
- decontamination equipment/supplies

2.2 Procedures

This section outlines the step-by-step procedures for collecting cores manually using a hand coring device. Observations made during core collection should be recorded on the Daily Activity Log and Individual Core Collection Form, and in a logbook (SOP No. 1 – Field Documentation).

2.2.1 Decontamination of Equipment

Decontamination of the polycarbonate (or polybutyrate) core tubes and stainless steel core catcher will be performed in accordance with procedures outlined in SOP No. 2 – Decontamination. The decontamination activities will occur on shore and will be conducted with enough time before vessel departure to allow for the decontamination activities to be completed (including drying of the decontaminated equipment). A sufficient amount of decontaminated equipment will be brought on the coring vessel for the planned coring activities for that day.

2.2.2 Locating Coring Position

1. The coring schedule for the day will be established prior to vessel departure and sufficient equipment to complete the work will be on board the sampling vessel. The coring crew will be informed of the coring locations prior to departure.

2. The coring vessel will move to a coring location in accordance with SOP No. 4 – Positioning.

2.2.3 Core Collection

Follow the steps below to complete core collection activities.

1. Complete the Daily Activity Log.

2. Don PPE as required by HASP (Appendix D of the SRIWP).

3. Activate the submersible pump in preparation of cleaning the coring tube and core driver during retrieval.

4. Obtain the water depth (to nearest 0.1 foot) from the fathometer (or lead line) and record on the Individual Core Collection Form.

5. Determine the minimum length of core needed using the following equation:

   Minimum core length needed (feet) = water depth (feet) + target penetration (feet) + 1 foot + stick-up/core driver (feet)

6. On the coring tube, mark the distance to drive the core (target penetration [feet] + water depth [feet] + 1 foot [i.e., plug]). An additional foot of sediment is collected to obtain a "plug" at the bottom of the core (i.e., to minimize the loss of sediment from the core). If necessary, a core catcher may be used to prevent sediment from escaping.

7. The core will be collected without the use of a core catcher. If the sediment cannot be retained in the core tube without a core catcher, then one will be used.

8. If a core catcher is required, the core catcher will be attached to the bottom of the core tube prior to lowering the core tube into the water.

9. Gently place hand corer on top of the sediment.

10. Lightly drive the coring tube, with straight, vertical entry, into the sediment with a core driver until the targeted core depth is reached (or refusal), as indicated by the markings.

11. Measure and record the penetration on the Individual Core Collection Form. Record final core location coordinates on the Individual Core Collection Form.

12. To prevent the loss of sediment from the core tube, either use a vacuum pump affixed to an appropriate fitting or use a one-way valve at the top of the core tube.

13. Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

14. Before the bottom of the coring tube breaks the water surface, place a cap over the bottom to prevent the loss of material from the core tube. Place the cap on the core tube by reaching down into the water.

15. If using a core catcher, remove the core from the water and bring aboard the sampling vessel deck. Remove the core catcher and secure a cap in place with duct tape.

16. Bring the core to the vessel's deck and secure the cap in place with duct tape.

17. Clean the core tube and core driver on the vessel by hosing them down with

Hackensack River water. Remove the one-way valve.

18. Evaluate whether core penetration and recovery are acceptable using the procedures outlined in Sections 2.2.4 and 2.2.5, respectively.

19. Keeping the core tube upright, use a hacksaw with a decontaminated blade or drill with a decontaminated drill bit to make a cut/hole in the core tube approximately 3 to 4 inches above the sediment to allow excess water to seep from the core tube. Continue to make cuts/holes in the core tube, lowering 1 inch each time until reaching the sediment/water interface. When all of the excess water has been drained from above the sediment/water interface, cut off the excess core tube.

20. Cap the cut end of the tube, secure the cap with duct tape, and draw an arrow toward this cap. Label "top" to indicate the top of the core. Label the core with the location ID, date, and time, and record this information on the Individual Core Collection Form.

21. Measure the recovered length of the sediment in the core tube (to the nearest 0.1 foot to the extent possible) and record it on the Individual Core Collection Form. The distance between the top of the sediment in the coring tube and the bottom of the coring tube corresponds to the recovered length. Apparent gaps should be noted on the Individual Core Collection Form and the length and location(s) of the gap(s) noted. The total gap length will be subtracted from the total recovery length.

22. Store the core vertically in a core storage rack (capable of keeping cores cold) while on the vessel until it can be transported to the Sample Processing Area. Cores greater than 6 feet will be segmented on the vessel to allow for storage and transportation. Cut these cores at the location of a planned sample segmentation (see Table 4-4 of the SRIWP) using a hacksaw with a decontaminated blade and recap the exposed ends. Add appropriate markings to indicate the location and segmentation of each section.

2.2.4 Procedures for Determining Acceptable Core Penetration

1. Calculate penetration percentage using the following equation:

$$\text{Penetration}\,(\%) = \frac{\text{actual penetration}\,(\text{feet})}{\text{target penetration}\,(\text{feet})} \times 100$$

Actual penetration is the depth advanced into the sediment, not including the depth advanced to form a plug.

2. Record the penetration percentage on the Individual Core Collection Form.

3. If penetration is ≥ 75 percent, then penetration is acceptable. Proceed to Section 2.2.5, Procedures for Determining Acceptable Core Recovery.

4. If penetration is <75 percent, then (a) retain core and (b) record on the Individual Core Collection Form if the low penetration is due to refusal. Record additional penetration notes at the Notes section of the Individual Core Collection Form. Move to a new coring position in accordance with SOP No. 4 – Positioning. Upon three unsuccessful attempts to obtain >75 percent penetration, contact the Lead Consultant Project Manager to determine whether additional core collection should be attempted. Proceed to Section 2.2.5, Procedures for Determining Acceptable Core Recovery.

2.2.5 Procedures for Determining Acceptable Core Recovery

1. Calculate the recovery percentage by the following equation:

$$\text{Recovery}(\%) = \frac{\text{recovery}(\text{feet}) - \text{gaps (feet)}}{\text{actual penetration}(\text{feet})} \times 100$$

2. Record the recovery percentage on the Individual Core Collection Form.

3. If recovery is ≥75 percent, then recovery is acceptable. Continue processing core, then move to a new core location in accordance with SOP No. 4 – Positioning. Proceed to Step 2 of Section 2.2.3 for collection of a second core. If the recovery is <75 percent, proceed to Step 4.

4. If recovery is <75 percent, then (a) retain core and (b) move to a new coring position in accordance with SOP No. 4 – Positioning. Upon three unsuccessful attempts to obtain >75 percent recovery, contact the Lead Consultant Project Manager to determine whether additional cores should be attempted.

5. Upon collection of acceptable core(s), proceed to Section 2.2.6 of this SOP, Management of Cores.

2.2.6 Management of Cores

1. Assign the “primary” core designation to the first acceptable core. If >75 percent recovery was not achieved, assign the “primary” core designation to the core with the highest recovery. Record the “primary” core in the Notes

section of the Individual Core Collection Form and mark “primary” on the core liner.

2. If more than two cores were collected, return excess sediment into the Hackensack River at the core location. Dispose of solid material (e.g., core tube, caps) in accordance with SOP No. 13 – Management and Disposal of Residuals.

3. Verify that the lengths of the core tubes, water depth, and positioning data have been recorded on the Individual Core Collection Form.

4. Prior to transit to the next coring location or return to the marina, decontaminate the core driver and sampling vessel decking as described in SOP No. 2 – Decontamination.

5. Proceed to next core location specified for that day and repeat above procedures.

6. Completed Individual Core Collection Form will be provided to the Sample Processing Area personnel when relinquishing cores for processing.

3. Quality Assurance

Completing the Daily Activity Log and the Individual Core Collection Form provided in SOP No. 1 – Field Documentation will document that the process is being followed and the pertinent information is being collected and recorded in accordance with the procedures outlined in this SOP. Entries in the forms will be double-checked by the samplers to verify the information is correct. Completed forms will be reviewed periodically by the Lead Consultant Project Manager or designee to verify that the requirements are being met.

4. Documentation

Field notes will be kept during coring activities in accordance with SOP No. 1 – Field Documentation. In addition to information contained in the Daily Activity Log and Individual Core Collection Form, the times of equipment decontamination will be recorded in a logbook.

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Standard Operating Procedure No. 7

Sediment Collection Using Vibracoring Device

January 2009

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for collecting cores using a vibracoring device as part of the Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP).

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to collect cores. Specific information regarding coring can be found in the SRIWP.

This SOP may change, depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator and the New Jersey Department of Environmental Protection Site Manager. The ultimate procedure employed will be documented in the HRSA Supplemental Remedial Investigation Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Decontamination
- SOP No. 4 – Positioning
- SOP No. 8 – Core Processing
- SOP No. 13 – Management and Disposal of Residuals

2. Procedures

Cores may be collected within the HRSA using a vibracoring device. Following collection, cores will be transported to the Sample Processing Area. Core processing procedures are described in SOP No. 8 – Core Processing.

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by the SRIWP

- navigation charts and Proposed Sediment Sampling Locations figure (Figures 4-1 and 4-2 of the SRIWP)
- sampling vessel adequate for Hackensack River conditions
- marine very high frequency (VHF) radio
- positioning equipment
- vibracore device
- deployment equipment (e.g., A-frames, winches, generator)
- decontaminated polycarbonate (or polybutyrate) core tubes
- decontaminated stainless steel core catcher
- decontaminated stainless steel core cutter
- hacksaw
- decontaminated hacksaw blades
- decontaminated drill bits
- drill
- Daily Activity Log and Individual Core Collection Form (SOP No. 1 – Field Documentation)
- core storage racks to hold cores vertical and cold during temporary storage on board the coring vessel
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices)
- logbooks
- permanent marker or grease pencil
- fathometer (or lead line) with a resolution of 0.1 foot
- tape measure

- submersible pump and hose
- duct tape
- camera
- decontamination equipment/supplies

2.2 Procedures

This section gives the step-by-step procedures for collecting cores using a vibracore. Observations made during sediment core collection should be recorded in the Daily Activity Log and Individual Core Collection Form, and a logbook (SOP No. 1 – Field Documentation).

2.2.1 Decontamination of Equipment

Decontamination of the polybutyrate core tubes, stainless steel core cutter, and stainless steel core catcher assemblies will be performed prior to vessel departure in accordance with procedures outlined in SOP No. 2 – Decontamination. The decontamination activities will occur on shore and will be conducted with enough time before vessel departure to allow for the decontamination activities to be completed (including drying of decontaminated equipment). A sufficient amount of decontamination equipment and supplies will be brought on the coring vessel to accommodate the need for miscellaneous, unforeseen decontamination.

2.2.2 Locating Coring Position

1. The coring schedule for the day will be established prior to vessel departure, and sufficient equipment to complete the work will be on board the sampling vessel. The coring crew will be informed prior to departure of the coring locations and the number of cores required at each location.

2. The vibracoring vessel will move to a coring location in accordance with SOP No. 4 – Positioning.

2.2.3 Core Collection

Follow the steps below to complete core collection activities.

1. Complete the Daily Activity Log.

2. Don PPE as required by HASP (Appendix D of the SRIWP).

3. Activate the submersible pump in preparation for cleaning the vibracore and coring tube, upon retrieval.

4. Attach the steel core casing and core tube into the vibracore head as it lies horizontally on the deck. Secure the core catcher and core cutter to the end of the core casing.

5. Slowly winch the vibracore into its deployment orientation.

6. Obtain the water depth (to nearest 0.1 foot) from the fathometer and record on Individual Core Collection Form.

7. Slowly lower the vibracore into the water using the winch or other deployment equipment.

8. Slowly lower the vibracore through the water column to the sediment surface using the water depth reading.

9. Record the “zero” mark on the winch cable.

10. Slowly lower the vibracore into sediment under its own weight until it stops. Turn on the motor. Record the start time on the Individual Core Collection Form. Slowly penetrate the sediment to the target penetration as indicated in Table 4-4 of the SRIWP, or refusal.

11. Lower the vibracore approximately 1 foot more to obtain a “plug” at the bottom of the core (i.e., to minimize loss of sediment from core). Record the end time on the Individual Core Collection Form.

12. Upon completion of the required penetration, or upon vibracore refusal, turn off the motor. Record the vibracore penetration depth on the Individual Core Collection Form.

13. Record the final core location coordinates on the Individual Core Collection Form.

14. Slowly raise the vibracore, while maintaining the core in a vertical position.

15. Clean the vibracore barrel and coring assembly by hosing down the equipment with Hackensack River water as described in SOP No. 2 – Decontamination.

16. Remove the core tube from the vibracore barrel and place a cap on the bottom of the coring tube, keeping the core tube in an upright position.

17. Return the vibracore device to its onboard, deck storage location.

18. Clean the core tube by hosing it down with Hackensack River water. Care should be taken not to direct water into the open end of the core tube.

19. Evaluate whether core penetration and recovery are acceptable using the procedures outlined in Sections 2.2.4 and 2.2.5, respectively.

20. Keeping the core tube upright, use a hacksaw with a decontaminated blade or drill with a decontaminated drill bit to make a cut/hole in the core tube approximately 3 to 4 inches above the sediment to allow excess water to seep from the core tube. Continue to make cuts/holes in the core tube, lowering 1 inch each time until reaching the sediment/water interface. When all excess water has been drained from above the sediment/water interface, cut off the excess core tube.

21. Cap the cut end of the tube, secure the cap with duct tape, and draw an arrow toward the cap. Draw an arrow on the coring tube with permanent marker and label "top" to indicate the top of the core. Label the core with the location ID, date, and time, and record this information on the Individual Core Collection Form.

22. Measure the recovered length of the sediment in the core tube (to the nearest 0.1 foot to the extent possible) and record it on the Individual Core Collection Form. The distance between the top of the sediment in the coring tube and the bottom of the coring tube corresponds to the recovered length. Apparent gaps should be noted on the Individual Core Collection Form and the length and location(s) of the gap(s) should be noted. The total gap length will be subtracted from the total recovery length.

23. Store the core vertically in a core storage rack (capable of keeping cores cold) while on the vessel until it can be transported to the Sample Processing Area. Cores greater than 6 feet will be segmented on the vessel to allow for storage and transportation. Cut these cores at the location of a planned sample segmentation (see Table 4-4 of the SRIWP) using a hacksaw with a decontaminated blade and recap the exposed ends. Add appropriate markings to indicate the location and segment of each section.

2.2.4 Procedures for Determining Acceptable Core Penetration

1. Calculate penetration percentage using the following equation:

$$\text{Penetration}\,(\%) = \frac{\text{actual penetration}\,(\text{feet})}{\text{target penetration}\,(\text{feet})} \times 100$$

Actual penetration is the depth advanced into the sediment, not including the depth advanced to form a plug.

2. Record the penetration percentage on the Individual Core Collection Form.

3. If penetration is ≥ 75 percent, then penetration is acceptable Proceed to Section 2.2.5, Procedures for Determining Acceptable Core Recovery.

4. If penetration is <75 percent, then (a) retain core and (b) record on the Individual Core Collection Form if the low penetration is due to refusal. Record additional penetration notes at the Notes section of the Individual Core Collection Form. Move to a new coring position in accordance with SOP No. 4 – Positioning. Upon three unsuccessful attempts to obtain >75 percent penetration, contact the Lead Consultant Project Manager to determine whether additional core collection should be attempted. Proceed to Section 2.2.5, Procedures for Determining Acceptable Core Recovery.

2.2.5 Procedures for Determining Acceptable Core Recovery

1. Calculate the recovery percentage by the following equation:

$$\text{Recovery}(\%) = \frac{\text{recovery}(\text{feet}) - \text{gaps (feet)}}{\text{actual penetration}(\text{feet})} \times 100$$

2. Record the recovery percentage on the Individual Core Collection Form.

3. If recovery is ≥75 percent, then recovery is acceptable. Continue processing core, then move to a new core location in accordance with SOP No. 4 – Positioning. Proceed to Step 2 of Section 2.2.3 for collection of a second core. Note that only the biologically active zone (BAZ) interval (0 - 0.5 foot) is necessary from the second core with a targeted penetration of 1.5 feet. If the recovery is <75 percent, proceed to Step 4.

4. If recovery is <75 percent, then (a) retain core and (b) move to a new coring position in accordance with SOP No. 4 – Positioning. Upon three unsuccessful attempts to obtain >75 percent recovery, contact the Lead Consultant Project Manager to determine whether additional cores should be attempted.

5. Upon collection of acceptable core(s), proceed to Section 2.2.6 of this SOP, Management of Cores.

2.2.6 Management of Cores

1. Assign the “primary” core designation to the first acceptable core. If >75 percent recovery was not achieved, assign the “primary” core designation to the core with the highest recovery. Record the “primary” core in the Notes section of the Individual Core Collection Form and mark “primary” on the core liner.

2. If more than two cores were collected, return excess sediment into the Hackensack River at the core location. Dispose of solid material (e.g., core tube, caps) in accordance with SOP No. 13 – Management and Disposal of Residuals.

3. Verify that the lengths of the core tubes, water depth, and positioning data have been recorded on the Individual Core Collection Form.

4. Prior to transit to the next coring location or return to the marina, decontaminate the coring equipment and sampling vessel decking as described in SOP No. 2 – Decontamination.

5. Proceed to next core location specified for that day and repeat above procedures.

6. Completed Individual Core Collection Form will be provided to the Sample Processing Area personnel when relinquishing cores for processing.

3. Quality Assurance

Completing the Daily Activity Log and the Individual Core Collection Form provided in SOP No.1 – Field Documentation will document that the process is being followed and that pertinent information is being collected and recorded in accordance with the procedures outlined in this SOP. Entries in the forms will be double-checked by the samplers to verify the information is correct. Completed forms will be reviewed periodically by the Lead Consultant Project Manager or designee to verify that the requirements are being met.

4. Documentation

Field notes will be kept during coring activities in accordance with SOP No. 1 – Field Documentation. In addition to information contained in the Daily Activity Log and Individual Core Collection Form, the times of equipment decontamination will be recorded in a logbook.

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Standard Operating Procedure No. 8

Core Processing

January 2009

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for processing of the cores collected as part of the Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP). Core processing includes observational and photologging of cores, collection of samples from the cores for grain size, and chemical analyses. Core processing will be conducted to meet the sample collection and analysis objectives defined in the SRIWP.

This SOP may change depending upon field conditions at Hackensack River or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator and the New Jersey Department of Environmental Protection Site Manager. The ultimate procedure employed will be documented in the HRSA Supplemental Remedial Investigation Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Decontamination
- SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 6 – Sediment Collection Using Hand Coring Device
- SOP No. 7 – Sediment Collection Using Vibracoring Device
- SOP No. 13 – Management and Disposal of Residuals Tissue Sampling

2. Procedures

Cores will be processed in accordance with the procedures outlined below.

2.1 Equipment List

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment and other safety equipment, as required by the SRIWP
- sample processing table
- logbook and associated Core Lithology/Description Form and Sample Processing Form (SOP No. 1 – Field Documentation)
- ruler or measuring tape
- hacksaw and spare decontaminated blades
- table of target sample location coordinates
- electric sheet metal shears or similar
- sampling equipment: stainless steel spatulas and bowls
- sample bottles for chemical analyses
- refrigerator, at 4^{o} Celsius
- digital camera with flash
- EnCore samplers and T-handle
- pH/oxidation-reduction potential (ORP) electrode
- stainless steel dividing blades/knives
- ARCADIS and/or Unified Soil Classification System (USCS) Charts
- photoionization detector (PID) (with calibration kit)
- core storage rack to hold cores vertical and keep cold prior to either processing or placement in a refrigerator
- appropriate waste disposal equipment
- scales to weigh sediment cores and samples

2.2 Procedure

The core processing procedure presented in this SOP is a multi-step process. The exact procedures and steps will depend on whether the core contains high-water content sediments (i.e., material that would slump if placed horizontally). In advance of processing, each core will be visually inspected to determine whether it contains high-water content sediments, and consequently, whether it can be processed horizontally or vertically. Cores will then be logged and photographed, and samples will be collected and submitted for grain size and chemical analyses.

2.2.1 Decontamination of Equipment

Decontamination of equipment prior to contact with sediment will be performed in a designated decontamination area. The decontamination will be performed in accordance with procedures outlined in SOP No. 2 – Decontamination. Equipment decontamination will be conducted sufficiently ahead of the processing activities to allow for the implementation of proper procedures (including drying of decontaminated equipment).

2.2.2 Preliminary Activities Prior to Processing

The following steps will be undertaken prior to core processing:

1. Acquire the necessary sampling equipment (e.g., decontaminated stainless steel processing equipment), containers, and label the sample containers with the appropriate sample labels.

2. Upon delivery of the core to the processing laboratory, a hard copy of the forms initiated for each core during coring operations, the Daily Activity Log and the Individual Core Collection Form will be provided to the Sample Processing Area personnel (SOP No. 1 – Field Documentation). The Individual Core Collection Form will be signed by the coring personnel and the Sample Processing Area personnel. The Individual Core Collection Form will serve as the chain-of-custody document from the field to the Sample Processing Area.

3. Cores will be maintained in a vertical position in a core storage rack (capable of keeping cores cold) while in transit to the Sample Processing Area. At the Sample Processing Area, cores will be stored vertically and kept cold (in either the refrigerator or core storage rack) prior to processing. The Sample Processing Area will be within a secure (i.e., locked) location, allowing for limited access.

4. Transcribe the pertinent field information from the Individual Core Collection Form to the Core Lithology/Description Form.

5. Dry the surface of the core tube with clean paper towels and measure the length of the core tube.

6. Keeping the core vertical, remove the top cap from the core to be processed. Visually inspect the sediment in the biologically active zone (BAZ; 0 to 0.5 feet below the sediment surface) and near-surface sediments to determine whether they are high-water content sediments. High-water content sediments would slump if placed horizontally.

7. If the BAZ and near-surface sediments consist of high-water content sediments then the core will be processed as described in Section 2.2.3 below.

8. If the BAZ and near-surface sediments do not consist of high-water content sediments, then the core will be processed as described in Section 2.2.4 of this SOP.

2.2.3 Core Processing for High-Water Content Sediments

As previously described, if the core contains high-water content sediments, then the procedures outlined in this section will be used. The procedures involve keeping the core in a vertical position and then carefully removing the high-water content sediments into a stainless steel bowl for processing or directly into the EnCore samplers for volatile organic compound (VOC) analysis. The cores cannot be placed horizontally until sediment of sufficiently low water content is reached, such that the sediment will not slump when placed horizontally on the core processing table.

1. With the core in the vertical position, mark the outside of the core tube in 2-inch increments, beginning at the sediment-water interface, and proceeding down far enough until it is expected that low-water content sediments will be encountered. Also, mark the core tube with the sample interval boundaries for chemical analysis, beginning at the same location.

2. While the core is in a vertical position, remove the sediment from the segment using a stainless steel utensil and place the sediment in a stainless steel bowl.

3. Screen the sediment in the bowls with a PID and pH/ORP electrode, and record in the Core Lithology/Description Form.

4. For VOC analysis, the sediment will be placed into an EnCore sampler until the sampler is full. Sediment for VOC analysis will be collected with three EnCore samplers. Collect a sample for moisture content (for use in VOC analysis) from the same location as the VOC samples were collected. Collect the moisture content samples using a stainless steel utensil and place in the appropriate sample containers.

5. Visually describe the sediments in the stainless steel bowls. Using the USCS record the description of the soil type in the appropriate section of the Core Lithology/Description Form. Provide a description of approximate grain size (silt, clay, fine sand, medium sand, coarse sand, and gravel), the presence of observable biota or organic matter, odor, and color. Note any unusual observations in the appropriate column. Identify changes in lithology (such as soil type or grain-size) within the core. If changes in lithography are observed, then the approximate length of various layers will be noted. Changes in lithology will be separated with a line on the Core Lithology/Description Form.

6. Photograph the sediment in the stainless steel bowls. If foreign objects are present or unusual characteristics are noted, photograph the object or unusual characteristic. Make sure an adequate amount of light is available to photograph the sediment.

7. Record a description of each photograph in a logbook. Descriptions will include photo number, date, time (Eastern Standard Time), core number, depth interval shown in picture, and photographer's name. Unusual observations will also be recorded.

8. Thoroughly mix the sample in the center of a stainless steel bowl for chemical analysis. Homogenize the sediment until color and texture differences are no longer detected.

9. Fill pre-labeled sample jars for remaining chemical analyses in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. Sediment samples for chemical analyses will be obtained from the bowl with homogenized sediment. Confirm that the sample identification has been recorded on the Sample Processing Form.

10. If determined necessary by the Sample Processing Area personnel, the individual sample bottles may be weighed to ensure appropriate sample volume for lab analysis.

11. Remaining sediment and core tube lengths will be stored or disposed of in accordance with SOP No. 13 – Management and Disposal of Residuals.

12. The sample containers will be labeled and processed according to SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

13. For the next sample interval, visually inspect the core to determine whether the next interval contains high-water content sediments. If the core does not contain high-water content sediments, then the remaining core segments can be processed as described in Section 2.2.4 below. If the core does contain high-water content sediments, continue to process the core following these procedures.

2.2.4 Core Processing for Non-High-Water Content Sediments

As described above, if the core does not contain high-water content sediments, then the procedures outlined in this section will be used. The procedures involve:

- Laying the core horizontal and splitting it lengthwise
- Screening the core with a PID and pH/ORP electrode, and collecting samples for VOC analysis
- Logging and photologging the core
- Collecting sediment samples for analysis

Detailed procedures are as follows:

1. Transfer the core to the sample processing table.

2. Using the electric sheet metal shears (or other cutting device), make two longitudinal cuts along the core tube, one on each side. Open the tube lengthwise and carefully split the core in half. Decontaminated stainless steel dividing plates may be used to ensure equal sectioning.

3. Screen the core with a PID and pH/ORP electrode, and record on the Core Lithology/Description Form one reading for every 0.5 foot of core screened.

4. Calculate sample intervals for chemical samples using the Sample Processing Form in accordance with Section 2.2.5 of this SOP. Mark the specified sampling interval ranges on the outside of the core tube.

5. Prior to collecting samples, transcribe the pertinent field information from the Individual Core Collection Form to the Sample Processing Form.

6. Remove the smear zone of the specified range to be sampled. To remove the smear zone, scrape sediment exposed to the core tube and discard in accordance with SOP No. 13 – Management and Disposal of Residuals.

7. Immediately after smear zone removal, remove EnCore sampler from bag. Hold EnCore sampler coring body and push the plunger rod down until the small O-ring rests against the tabs. This will ensure that the plunger moves freely. Sediment for VOC analysis will be collected with three EnCore samplers.

8. Depress the locking lever on the EnCore T-handle. Place coring body, plunger end first, into the open end of the T-handle aligning the slots on the coring body with the locking pins on the T-handle. Twist the coring body clockwise to lock the pins in the slots. Check to ensure the EnCore Sampler is locked in place.

9. Turn the T-handle with the “T” up and the coring body down. Using the T-handle, push the sampler into the sediment in one half of the core tube until the coring body is completely full (when full, the small O-ring will be centered in the T-handle viewing hole). Remove the sampler from the sediment and wipe excess sediment from the coring body exterior.

10. Cap the sampler while it is still on the T-handle. Push the cap over the flat area of the ridge and twist to lock the cap in place. The cap must be seated to seal the sampler. If the cap appears crooked, the locking arms are not fully seated over the coring body ridge. Remove the cap and reseat.

11. Remove the capped sampler by depressing the locking lever on the T-handle while twisting and pulling the sampler from the T-handle.

12. Lock the plunger by rotating the extended plunger rod fully counterclockwise until the wings rest firmly against the tabs.

13. Attach completed circular label (from the EnCore sampler bag) over the cap.

14. Return the full EnCore sampler to its bag, seal the bag, and place in transportation cooler on ice. Package and label the sample container following the procedures in SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

15. Continue collecting the VOC samples as described in Steps 7 through 14 for each segment of the core (see Table 4-4 of the SRIWP). Collect a sediment grab sample for moisture content from the same location as the VOC samples (for use in the VOC analysis). Collect the moisture content sample using a stainless steel utensil and place in the appropriate sample container.

16. With the core split open, visually describe the core. Using the USCS, record the description of the soil type in the appropriate section of the Core Lithology/Description Form. Provide a description of approximate grain size (silt, clay, fine sand, medium sand, coarse sand, and gravel), the presence of observable biota or organic matter, odor, and color. Note any unusual observations in the appropriate column. Identify changes in lithology (such as soil type or grain-size) within the core. If changes in lithography are observed, then the approximate length of various layers will be noted. Changes in lithology will be separated with a line on the Core Lithology/Description Form.

17. Photograph the exposed section of the core. Include a ruler or measuring tape for scale and mark the top, bottom, and ends of the core. If foreign objects or gaps are present, or unusual observations are made, photograph the object or subject of the observations. Make sure an adequate amount of light is available to photograph core.

18. Record a description of each photograph in a logbook. Descriptions will include photo number, date, time (Eastern Standard Time), core number, depth interval shown in picture, and photographer's name. Unusual observations will also be recorded.

19. For each sample interval, collect sediment using a decontaminated stainless steel utensil from one half of the split core and place in the appropriate decontaminated stainless steel bowl.

20. Thoroughly mix the sample in the center of a stainless steel bowl. Homogenize the sediment until color and texture differences are no longer detected.

21. Fill pre-labeled sample jars for remaining chemical analyses, in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. Confirm that the sample identification has been recorded on the Sample Processing Form.

22. If determined necessary by the Sample Processing Area personnel, the individual sample bottles may be weighed to ensure appropriate sample volume for lab analysis.

23. Remaining sediment and core tube lengths will be stored or disposed of in accordance with SOP No. 13 – Management and Disposal of Residuals.

24. The sample containers will be labeled and processed according to SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

2.2.5 Core Sample Interval Selection

Table 4-4 of the SRIWP presents the selection of the target sample intervals. A list of sample containers to be used for each analysis is specified in SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

2.2.6 Collection of Quality Assurance Samples

2.2.6.1 Field Quality Control Samples

Quality control (QC) samples will be collected during core sample processing. These samples will be labeled, maintained, and transported in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. QC samples will include rinsate blanks and field duplicate samples, and will be collected at the frequency specified in Table 7-2 of the SRIWP.

2.2.6.2 Rinsate Blanks

For the core processing, one rinsate blank will be collected for every 20 field samples (not to exceed one per day). The procedures for the collection of rinsate blanks are described in SOP No. 2 – Decontamination. The parameters that are being analyzed in the rinsate samples are listed in Table 4-9 of the SRIWP. The rinsate sample is labeled, maintained, and transported in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

2.2.6.3 Trip Blanks

Trip blanks (volatiles only) are required when samples are analyzed for volatile organics. The trip blank is water obtained from the analytical laboratory and carried with the field sample bottles during the sampling event. When the sampling event has ended, the trip blanks are labeled and shipped to the laboratory along with representative field samples for volatile analysis only. Trip blanks will be processed at a frequency of one for each cooler shipped from field to laboratory which contains field samples for volatiles analysis.

2.2.6.4 Field Duplicate Samples

Field duplicate samples will be collected following the same procedures as the collection of samples for chemical analysis. One field duplicate sample will be collected for every 20 field samples (per matrix and per method). The duplicate samples will be labeled, maintained, and transported in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

2.2.6.5 Laboratory Quality Control Samples

Matrix spike/matrix spike duplicates (MS/MSD) are required as laboratory QC tests for organic analyses, while matrix spike/duplicates (MS/DUP) are required as laboratory QC tests for metals and cyanide analyses. Within each Sample Delivery Group, one MS/MSD (for each organic analysis type) and MS/DUP (for each inorganic analysis type) must be collected for each analytical group submitted. It is not necessary that the MS/MSD or MS/DUP be derived from the same sample. Therefore, field personnel will designate a sediment sample from each sample delivery group to be used for these analyses for each analytical method. Minimum sample analysis mass requirements, as well as additional Laboratory QC sample mass requirements, are provided in Table 4-7 of the SRIWP.

3. Quality Assurance

Completing the Core Lithology/Description Form and Sample Processing Form provided in SOP No. 1 – Field Documentation, will document that the process is being followed and pertinent information is being collected and recorded in accordance with the procedures outlined in this SOP. Entries in the forms and logbook will be double-checked by the samplers to verify the information is correct. Completed forms will be reviewed periodically by the Lead Consultant Project Manager or designee to verify that the requirements are being met.

4. Documentation

Field notes will be kept during core processing activities in accordance with SOP No. 1 – Field Documentation. The core weights and sample weights (if collected) will be recorded in the logbook. In addition, the following core photologging information should be included in the logbook (at a minimum):

- photo number
- time of photo

- core number
- depth interval shown in the picture
- photographer's name
- unusual observations

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Standard Operating Procedure No. 9

Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests

January 2009

Revision 0

1. Purpose and Scope

This Standard Operating Procedure (SOP) describes the procedures to be followed for the collection of composite surface sediment samples from the Hackensack Study Area (HRSA) and reference areas during implementation of the Supplemental RI Work Plan (SRIWP). Surface sediment sampling will be performed to collect sediment chemistry data in conjunction with the ecological investigations being performed, and to collect bulk sediment for toxicity tests.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Decontamination
- SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 4 – Positioning
- SOP No. 10 – Benthic Invertebrate Community Study
- SOP No. 13 – Management and Disposal of Residuals

2. Preparations for Sampling

The SRIWP identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the SRIWP prior to conducting field activities and ensuring that all field equipment, including sample containers and preservatives are available and in acceptable condition.

3. Equipment

Equipment to be used during the collection of sediment samples may include, but is not limited to the following:

- sampling vessel
- stainless steel, modified Van Veen, or other equivalent grab sampler (e.g., petite, ponar)
- stainless steel bowls/buckets or equivalent containers

- sample containers
- set ice
- insulated coolers
- sample identification labels/tags
- waterproof marking pens
- stainless steel spoons/spatula
- Differential Global Positioning System (DGPS)

4. Equipment Decontamination

Decontamination of surface sediment sampling equipment will be performed between each composite sampling location/event in accordance with procedures outlined in SOP No. 2 – Decontamination. Personnel decontamination procedures are contained in the Health and Safety Plan (Appendix D to the SRIWP).

5. Location of Sampling Stations

The following procedures will be used to locate the random sediment grab sample locations within each sampling station on the mudflat.

1. The sampling stations will be delineated using DGPS, as described in SOP No. 4 – Positioning.

2. Three grids of multiple 10-foot^2 squares, centered on each sampling station, will be generated using a DGPS. The target grid size will be 100 feet^2. A 100-foot^2 grid will result in 132 nodes, each node being represented by a latitude/longitude coordinate. If the sampling station is not large enough to support three non-overlapping 100-foot^2 grids, then smaller grids will be used. The minimum number of 10-foot^2 squares for each sediment sample grid will be 30, which would result in 48 nodes

3. Once the nodes and the coordinates for each sampling grid are established, a random number generator will be used to randomly select 20 nodes for discrete sediment grab samples.

6. Surface Sediment Sample Preparation and Collection

The following protocol will be implemented, as practicable, for collecting composite surface sediment samples. The analytical sample volume requirements for sediment chemistry samples are provided in Table 4-7 of the SRIWP. Approximately 10 liters of sediment are required for each sediment toxicity sample. The appropriate sample containers will be provided by the contract laboratory(s) prior to the field program. For the central sample, sufficient volume will be collected to conduct both chemistry and toxicity analyses. In addition, three discrete grab samples will be randomly collected from the central location for benthic community analyses as described in SOP No. 10 - Benthic Invertebrate Community Sampling. For the other two sampling locations (within each station), sufficient volume will be collected for chemical analyses only.

A modified Van Veen (or equivalent) grab sampler will be used to collect a sufficient volume of surface sediment at a 0 to 6-inch depth interval. Composite surface sediment samples collected from each of the three locations per station will consist of at least 10 grabs (discrete collections) that are combined and homogenized. Only "successful grabs" (i.e., consisting of complete closure of sampling device jaws and devoid of large quantities of gravel, rocks, sticks, leaves, and detritus) will be included in a composite sample.

Grab samples will be collected from the first 10 randomly selected nodes as identified in item 3 from Section 5.0 above within each of the three sampling station grids. If 10 grab samples are not sufficient to meet the sample volume requirements, then additional grabs will be collected from additional node locations from the list of 20 selected.

Samples collected for AVS/SEM and VOC analyses will each be collected from the first grab sample prior to homogenization or mixing. Sediment for AVS/SEM analysis will be collected from the center of the grab, placed into containers with no headspace, and capped as quickly as possible to minimize exposure to air. In addition, from the same initial grab and prior to homogenization, samples for VOCs will be taken immediately using the EnCore Sampling System or similar device and placed in a sample collection jar. Remaining sediment will then be mixed with the other grab samples, homogenized, and used for chemical analysis and/or toxicity testing.

Once the sufficient number of grab samples has been collected for the chemistry and toxicity samples from the central location, three discrete samples will be collected for the benthic community analyses as described in SOP No. 10 – Benthic Invertebrate Community Sampling (i.e., the benthic community samples will be the last three grab samples to be collected).

Sediment grab samples will be composited and homogenized following U.S. Environmental Protection Agency Region 2 guidance using the “core and quarter” method. Rocks, shells, and other debris will be first removed from the sample. The sediment is removed from the sampling device and placed in a decontaminated stainless steel pan, then thoroughly mixed using a decontaminated stainless steel spoon. The sediment in the pan is scraped from the sides, corners and bottom of the pan, rolled to the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample is mixed individually, and then rolled to the center of the container and the entire sample mixed again until fully homogenized.

The following procedures will be followed to obtain the surface sediment for chemistry and toxicity analysis:

1. Label the appropriate sample containers with the appropriate pre-printed sample identification labels.

2. Attach the line or cable to the modified Van Veen (or equivalent) grab sampler and spread the sampling jaws until they lock in the open position.

3. Secure the free end of the sampler line to a firm support (e.g., the boat, raft or dock) and deploy the sampler into the surface water slowly.

4. Provide the sampler with at least 2 feet of slack sampling line to facilitate settling of the sampling jaws into the sediment. NOTE: procedures 2, 3, and 4 may be skipped if samples of the substrate are conducted during low tide and access to the sampling location can be made by land.

5. After the sampler closes on the substrate, slowly retrieve the sampler to the surface. Care should be taken to retrieve the sampler as smoothly as possible to avoid the possibility of premature opening or loss of a portion of the sample.

6. Place the closed sampler into an appropriate clean container (e.g., stainless steel bucket or equivalent container) and open the jaws to release the sediment sample. The sample container should be sufficiently large to hold all ten discrete grab samples.

7. Remove sediment for AVS/SEM and VOC analyses the first individual, unhomogenized grab sample.

8. Fill the appropriate sample containers with sediment for AVS/SEM analysis using a stainless steel spatula or spoon, taking care to avoid the sediment layer touching

the grab apparatus. Fill sample container to the top with sediment eliminating headspace and reducing exposure to oxygen. Close and seal AVS/SEM container.

9. Collect sediment using EnCore Sampling System or similar device and place in sample collection jar for VOC analysis.

10. Combine sediment with other discrete samples in a second stainless steel container in preparation for composite mixing.

11. Repeat steps 3 through 6 for each grab (discrete collection) sample to be taken.

12. Place each of the grabs (discrete collection) into the sample container with the previous samples. At least ten grabs will be collected; additional grabs may be collected until the approximate target volume has been obtained as previously described in Section 5 of this SOP.

13. Homogenize the mixture of discrete samples in the stainless steel bucket or equivalent container. The resulting composite sample can be used for chemical analysis and/or toxicity testing.

14. Fill the appropriate sample containers with sediment using a stainless steel spatula or spoon. Fill sample containers to the top eliminating headspace and reducing exposure to oxygen.

15. Close and seal each container.

16. Check label on each sample container and cover the label with clear plastic tape. Wrap with bubble wrap and place in sealable plastic bag. Refrigerate or place in cooler containing ice. Ship to laboratories on ice in coolers.

17. Complete the appropriate Chain-of-Custody Form for each sample container.

18. Record sample station, water depth (if applicable), qualitative visual (or tactile) observations as well as any unusual odors or sheens observed in sediments.

7. Sample Containers, Preservation, Handling, and Tracking

Sample containers, handling, and preservation procedures for the sediment chemistry samples are described in SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

For the toxicity testing, the sample containers will consist of 2 ½-gallon plastic pails (or equivalent containers) for the approximate 10 liters of sample required for the testing. These containers will be shipped in coolers containing ice to the analytical laboratory for testing.

8. Quality Control Samples

To help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling, field quality control samples (QC samples) will be collected during the sediment sample collection and processing. The QC samples will be labeled in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis, and sent to the laboratory with the other samples for analysis. QC samples for sediment sample collection will include rinsate samples, field duplicate samples, and matrix spike samples, and will be collected at the frequency specified in the SRIWP.

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Standard Operating Procedure No. 10

Benthic Invertebrate Community Sampling

January 2009

Revision 0

1. Purpose and Scope

This Standard Operating Procedure (SOP) defines the procedures to be followed for the collection of benthic invertebrate samples from surface sediments in the Hackensack River Study Area (HRSA) and reference area during implementation of the Supplemental Remedial Investigation Work Plan (SRIWP). These procedures describe equipment and field procedures necessary to conduct benthic invertebrate community sampling.

Other SOPs will be utilized with this procedure, including:

- SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 4 – Positioning
- SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests

2. Procedures

The SRIWP identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the SRIWP prior to conducting field activities and ensuring that all field equipment, including sample containers and preservatives, is available and in acceptable condition.

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all materials on the equipment list may be required for a specific activity. Additional equipment may be required, pending field conditions.

- sampling vessel
- stainless steel, modified Van Veen grab sampler or other equivalent grab sampler (e.g., petite, ponar)
- 500-micron mesh sieves
- plastic bags

- sample containers
- plastic buckets
- insulated coolers
- sample identification labels/tags
- waterproof marking pens
- 10 percent solution of buffered formalin or equivalent preservative

3. Location of Sampling Stations

If sampling by boat, the sampling schedule for the day will be established prior to vessel departure, and sufficient equipment to complete the work will be on board the sampling vessel. The position and depth of the sampling location will be established prior to departure. The positioning procedures are described in SOP No. 4 – Positioning. The water depth of the sampling locations at each station will be determined using either a fathometer or weighted demarcated line.

If sampling by land, no positioning is required, and the sampling location will be recorded using a backpack Differential Global Positioning System. Sampling by land may be appropriate for locations where low tides and access to habitats provide favorable conditions for sampling.

4. Benthic Invertebrate Sample Collection and Preparation

The benthic community sample will consist of a composite sample derived from three sediment grabs from the same area at the central location (i.e., the sediment toxicity and chemistry location) of each station (SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests). The benthic invertebrate community sample will be collected after the samples have been collected for chemistry and toxicity testing.

1. Record the sampling station location, water depth (if applicable), and time of sample collection in the field logbook.

2. Label the sample containers with the appropriate pre-printed sample identification labels.

3. If sampling by boat, slowly lower the grab sampler into the sediment in a controlled manner. If sampling by land, slowly place grab sampler over desired area on the substrate.

4. After the sampler closes, slowly retrieve the sampler. Care should be taken to retrieve the sampler as smoothly as possible to avoid the possibility of premature opening or loss of a portion of the sample.

5. Once the grab sampler has been raised, confirm that the effort was successful by opening the sampler and ensuring it is full. To ensure accurate sampling, only complete samples should be retained.

6. Once a complete sample has been obtained, empty the grab sampler into an appropriate clean container (e.g., plastic bucket). Thoroughly remove all sediment from the sampler for inclusion in the sample processing.

7. Remove all large debris (i.e., rocks, leaves, sticks), then pass the entire sediment sample through a standard 500-micron mesh sieve by agitating the sieve in a sieve box containing river water to wash away the sediments.

8. Place organisms and detrital material retained on the sieve into a labeled, plastic container and add a 10 percent solution of buffered formalin or equivalent preservative prepared in advance.

9. Place the container in an insulated cooler for storage until shipment to the laboratory.

5. Sample Handling and Preservation

Sample containers, handling, and preservation procedures are described in SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

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Standard Operating Procedure No. 11

Fish Tissue Sampling

January 2009

Revision 0

Figures

1. Purpose and Scope

This Standard Operating Procedure (SOP) defines the procedures to be followed for the collection of fish tissue samples from the Hackensack River Study Area (HRSA) and reference area during implementation of the Supplemental Remedial Investigation Work Plan (SRIWP). The fish surveys and collections will be performed, as practicable, using gill nets and baited Gee traps. Although the details of sample collection will be influenced by site-specific conditions, certain aspects of sample collection can be standardized for fish sampling and collection. These procedures give descriptions of equipment, field procedures, and documentation necessary to conduct fish tissue sampling.

Other SOPs will be utilized with this procedure, including:

- SOP No. 2 – Decontamination
- SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 4 – Positioning
- SOP No. 13 – Management and Disposal of Residuals

2. Preparations for Sampling

The SRIWP identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the SRIWP prior to conducting field activities and ensuring that all field equipment, including sample containers and preservatives are available and in acceptable condition.

3. Equipment List

Equipment to be used during the collection of fish tissue samples may include, but is not limited to the following:

- sampling vessel
- gill nets
- Gee traps and bait
- weights and buoys (or floats)

- fish measuring board
- electronic scale
- fillet knife or scalpel
- anatomical examination checklist
- field guides and taxonomic keys
- plastic buckets and/or steel wash tubs
- sample containers
- bubble wrap
- ice (wet and dry)
- insulated coolers
- sample identification labels/tags
- waterproof marking pens
- plastic Ziploc bags

4. Equipment Decontamination

Decontamination of fish tissue sampling equipment will be performed between each sampling location/event in accordance with procedures outlined in SOP No. 2 - Decontamination. Personnel decontamination procedures are contained in the Health and Safety Plan.

5. Location of Sampling Stations

The position and depth of the sampling station will be established. The positioning procedures are described in SOP No. 4 – Positioning. The depth of the sampling station will be determined using either a fathometer, graduated survey rod, or weighted demarcated line.

6. Fish Tissue Sample Collection and Preparation

The following protocol will be implemented, as practicable, for collecting fish tissue samples from the HRSA at the appropriate sampling stations as described in the SRIWP.

6.1 Gill Netting

Gill nets approximately 150 feet long and consisting of six (6 by 24-foot panels) with mesh sizes of (1.0, 1.5, 2.5, 3.0, 3.5, and 4.0 inches) will be utilized. Each net consists of six different mesh types in order to capture various sizes of fish. Each net is equipped with lead weights and floats designed to hold the panels vertically in the water column (i.e., after deployment, the bottom of the net will be suspended at least one foot above the substrate to avoid contact with bottom debris). The nets will be anchored with appropriate weights, and buoy lines will be rigged within 1 to 2 feet of taut to allow for variations in tide (i.e., if nets are set at low tide, sufficient taut will be given to accommodate changes in surface water depths). To comply with federal boating regulations for navigable waterways, buoys will not be set in navigation channels of the River. This requirement may influence the actual location of the gill net deployments. These deployment techniques will ensure reasonable positioning of the net in the water column throughout the tidal cycle. If necessary, alternate sized gill nets (i.e., fewer panels) may also be utilized under this SRIWP.

Gill nets will be deployed perpendicular to shore during the late afternoon - early evening hours and retrieved the following morning, as practicable. Generally, fish activity increases during the night, and the catch retrieved the following day will be more representative of species movement within the area. Additionally, gill nets may be set during the day to capture variability in the fish community during daylight and at different tidal cycles. Fish species caught in the gill nets and targeted for tissue sample collection include, by order of preference, white perch (*Morone americana*), striped bass (*Morone saxatilis*), American eel (*Anguilla rostrata*), and Atlantic menhaden (*Brevoortia tyrannus*).

The following protocols will be followed, as practical, for collecting fish with the gill nets.

1. Position the vessel at the site the gill nets are to be set.

2. Attach floats and anchor weights to surface float lines and bottom lead lines of gill nets.

3. Examine bow of the vessel. Identify and cover with duct tape any cleats, exposed screws, and irregularities in deck rail where the net might become entangled during deployment.

4. Deploy gill nets perpendicular to shore/current from bow of vessel while vessel is in reverse. Note the time and location of deployment in the field logbook.

5. Retrieve gill nets after the desired interval. Approach the net from the downwind end and slowly pull the net onto the boat.

6. Stack the gill net into a cooler or wash tub in coils or figure eights, carefully removing fish as the net is pulled out of the water.

7. Place fish removed from the gill nets into a clean, labeled, holding container (e.g., insulated cooler).

8. Fish removed from the gill nets are identified, counted, weighed, measured (total length), and examined for gross pathological condition, including any abnormalities, disease conditions, or missing appendages. Figure 1 is an example fish data sheet for recording this information. Figure 2 is an example data sheet for recording gross external and internal pathology information. Pathology information will be recorded for a subset of the fish captured, including any individual fish with obvious gross morphological abnormalities.

6.2 Baited Gee Traps

Baited Gee traps will be deployed at three locations at each of the mudflat sampling stations. The primary goal of using these traps is to catch resident forage fish (mummichogs) for the tissue residue analysis, but as a secondary goal, the traps are also likely to catch other small forage fish (which may be used to evaluate community composition and will not be submitted for analysis). A representative sample of 10 to 15 fish may be used to generate weight and length (total) data for each species size class. If practicable, sex will be recorded for all fish retained for tissue analysis.

Each trap is made of reinforced aluminum mesh (1/4 inch), and can be buoyed with a small flotation device. Baited Gee traps will be preferentially set during the day on incoming tides (as possible) and in coordination with other sampling activities. If sampling activities do not allow for deployment of baited traps during the day, they will be deployed in the late afternoon/early evening hours and retrieved the following morning in the same manner as the gill nets. The following procedures for using the baited traps will be employed:

1. Place the bait into the mesh bag or on the hook attached to the center bow of the trap. Attach float or buoy to end of minnow trap line.

2. Lower the trap into the water from the side of the boat, making sure that the trap is securely anchored and oriented on the river bottom. A buoy should be clearly visible on the surface of the water so that the minnow trap can be easily retrieved.

3. Note the time and location of deployment in the field logbook.

4. Retrieve the traps.

5. Empty each trap into an individual clean holding container (*e.g.*, insulated cooler) by slowly pulling the two ends of the trap apart.

6. The total number of species captured will be recorded. The fish will be identified, weighed, measured (total length), and examined for overall condition, including any abnormalities, disease conditions, or missing appendages. Figure 1 is an example fish data sheet for recording this information. Figure 2 is an example data sheet for recording gross external and internal pathology information. Pathology information will be recorded for fish captured, including any individual fish with obvious gross morphological abnormalities

7. Sample Preparation and Preservation

Fish collected for tissue analysis will be dispatched using a fillet knife or scalpel to sever the spinal cord just posterior to the brain, placed in plastic bags labeled by sampling station and sampling time, and placed on wet ice in an insulated cooler. Samples will then be transferred to a freezer at the staging area, and shipped on dry ice (to ensure maintenance of temperatures below -20º Celsius). Specific instructions regarding the sample preservation are described in SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

7.1 Fish Sample Preparation

White perch, striped bass, and other predatory fish collected using gill nets will be composited based on sampling station, species, and size class. Composite samples of whole fish will be prepared. In the event that target species are not available, a surrogate predatory species will be substituted. The need for, and species acceptable for use as surrogate predatory species will be based upon the number of species and individuals collected during the first sampling event.

The target number of forage fish (i.e., mummichogs) per composite sample will be equal to the number of individuals required to achieve the sample weight needed for analysis. At a minimum, a composite sample will consist of two individuals. Effort will be made to collect a sufficient quantity of fish to ensure that each composite tissue sample represents the same size, sex, and species of fish. In the event that a sufficient quantity of the same sex and size class of a particular species is not obtained during sampling activities, tissue from either the opposite sex or from a different size class (but never different species) will be added to achieve the desired sample weight. The target weights for fish tissue samples are specified in Table 4-7 of the SRIWP.

Fish collected at a particular location will be retained in an individual holding container (e.g., insulated cooler) until sampling at that location is complete. Fish collected shall be archived until completion of sampling (to ensure that a sufficient number of fish of a given species, size, and sex are obtained). Fish identified for the composite samples will follow this protocol as applicable:

1. Whole fish will be combined as a composite. Samples will be transferred to appropriately labeled plastic bags.

2. Place the bag on ice in an insulated cooler, or in a freezer for storage until shipment.

3. Complete the appropriate Chain-of-Custody form for each sample container (SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis).

4. Ship sample in a cooler containing ice.

7.2 Fish Sample Preservation

Specific instructions regarding sample preservation are described in SOP No. 3 - Containers, Preservation, Handling and Tracking of Samples for Analysis.

8. Quality Control Samples

To help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling, field quality control samples (QC samples) will be collected during the fish tissue sample collection and processing. All QC samples will be labeled in accordance with SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples, and sent to the laboratory with the other samples for analysis. QC samples for fish tissue collection will include rinsate samples, field

duplicate samples, and matrix spike/matrix spike duplicate samples, and will be collected at the frequency specified in the SRIWP.

Figure 1 - Fish Data Form

CHECKLIST FOR PHYSICAL EXAMINATION OF FISHES			
Date Collected:	Date Examined:	Sampling Method:	Fish No.:
Location:	Station No.:		Length (mm):
Examiner(s):	Species:		Weight (g):
			Sex:
Weather Conditions (deployment:): Weather Conditions (collection):		Tide height (deployment): Tide height (collection):	
Tissue Samples	Frozen for analysis (Y/N):	Analytical Sample No:	
	Fixed for Pathology (Y/N):	Fixative:	

Figure 2 - Fish Pathology Form

EXTERNAL PHYSICAL EXAMINATION					
BODY FORM		ISTHMUS		BRONCHIAL CAVITY	
	Normal		Normal		Normal
	Emaciated		Enlarged		Growths
	Truncate		Hemorrhagic		Parasites
	Scoliosis	EYES		UROGENITAL OPENING	
	Lordosis		Normal		Normal
BODY SURFACE			Popeye		Inflamed
	Normal		Cloudy cornea	ANUS	
	Raised scales		Missing		Normal
	Swollen		Lens deformed		Inflamed
	Lesions		Lens parasites	LESIONS - Location(s)	
	Excess mucous		Lens cataract		Fins
	Reoriented scales	FINS			Head
	Growths		Normal		Eyes
	Parasites		Frayed - eroded		Mouth
	Wounds		Parasites		Peduncle
	Wounds - lamprey		Hemorrhagic		Ventral
LIPS AND JAWS			Gas Bubbles		Dorsal
	Normal	FINS - ERODED			Lateral
	Deformed		Dorsal		

EXTERNAL PHYSICAL EXAMINATION					
LIPS AND JAWS		FINS - ERODED			
	Growths		Pectoral		
SNOUT			Pelvic		
	Normal		Anal		
	Pugnose (Pughead)		Adipose		
	Growths		Caudal		
	Abrasions				
BARBELS		GILLS		BEHAVIOR	
	Normal		Normal		Gasping
	Deformed		Bright red		Flashing
	Missing		Brown		Lethargic
OPERCLE			Gas bubbles		Fin twitching
	Normal		Parasites		Convulsions
	Incomplete	PSEUDOBRANCH			Headup-taildown
			Normal		Head-tail whirling
			Enlarged		Pectoral fins folded forward
					Belly up
					Loss of balance
					Long axis whirling
OTHER OBSERVATIONS					

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Standard Operating Procedure No. 12

Crab Tissue Sampling

January 2009

Revision 0

Figures

1. Purpose and Scope

This Standard Operating Procedure (SOP) defines the procedures to be followed for the collection of crab samples and tissues from the Hackensack River Study Area (HRSA) and reference area during implementation of the Supplemental Remedial Investigation Work Plan (SRIWP). These procedures give descriptions of equipment, field procedures, and documentation necessary to conduct crab tissue sampling.

Other SOPs will be utilized with this procedure, including:

- SOP No. 2 – Decontamination
- SOP No. 3 – Containers, Preservation, Handling, and Tracking of Samples for Analysis
- SOP No. 4 – Positioning
- SOP No. 13 – Management and Disposal of Residuals

2. Preparations for Sampling

The SRIWP identifies sampling stations, frequency of sampling, sample type, and analytical procedures. The field team is responsible for reviewing the SRIWP prior to conducting field activities and ensuring that all field equipment are available and in acceptable condition.

3. Equipment List

Equipment to be used during the collection of fish tissue samples may include, but is not limited to the following:

- sampling vessel
- crab pots and bait
- buoys (or floats) and associated line
- shucking knives
- stainless steel spoons
- wet and dry ice

- insulated coolers
- sample identification labels/tags
- waterproof marking pens
- plastic Ziploc bags

4. Equipment Decontamination

Decontamination of crab tissue sampling equipment (e.g., traps, knives) will be performed between each sampling location/event in accordance with procedures outlined in SOP No. 2 - Decontamination. Personnel decontamination procedures are contained in the Health and Safety Plan.

5. Location of Sampling Stations

The position and depth of the sampling station will be established. The positioning procedures are described in SOP No. 4 – Positioning. The depth of the sampling location will be determined using either a fathometer or weighted, demarcated line.

6. Crab Tissue Sample Collection and Preparation

Crab pots, measuring approximately 3 feet by 2 feet by 1 foot, are made of coated wire and can be buoyed with a small floatation device. Since blue crabs are generally most active at night, the pots will be deployed during the late afternoon to early evening hours and retrieved the following morning, as practicable. However, crab pots may also be deployed and retrieved during a sampling day. The trapping effort will increase around the sampling location if insufficient numbers of crabs are captured.

The following protocol will then be implemented, as practicable, for collecting the crabs from the site:

1. Place the bait into the mesh bag or on the hook attached to the center bow of the crab pot. Attach a float or buoy to the end of the crab pot line.

2. Lower the crab pot into the water from the side of the boat, making sure that the pot is securely anchored and oriented on the river bottom. The buoy should be clearly visible on the surface of the water so that the crab pot can be easily retrieved.

3. Note the time and location of deployment in the field logbook.

4. Retrieve crab pots at desired intervals.

5. Upon retrieval of the pot, place crabs collected from the crab pots on ice in clean, labeled, holding containers (e.g., insulated coolers) designated for the specific sample location.

6. All crabs collected at each location should be examined and the sex, carapace width (horn to horn), and overall condition including the presence of eggs on females, as well as any abnormalities, disease conditions, or missing appendages will be recorded on the field data sheet. The catch per unit effort will also be recorded. Figure 1 is an example blue crab data sheet for recording this information.

Any additional organisms collected should be identified in the field and released. All species collected should be recorded in the field logbook.

7. Sample Preparation and Preservation

7.1 Sample Preparation

Composite samples of all soft tissues of blue crab (Figure 2) will be prepared from crabs collected at each sampling station (as described in Section 6). Preference should be given to compositing male blue crabs of similar relative size, as practicable. A sufficient number of crabs will be collected to meet the analytical sample weight for each tissue type specified in Table 4-7 of the SRIWP. Once the target tissue weight has been obtained, and the volatile organic compounds sample has been obtained, the sample will be homogenized using a decontaminated glass blender with a stainless steel blade. The following protocols will be implemented, as practicable, for preparing crab tissue samples.

For each sampling station, the crabs that are collected will be retained. Each crab selected will be examined and the sex and carapace width recorded. Crabs will be dissected and all soft tissue composited according to the following protocol as practicable.

1. Prior to removal of tissues, each crab should be rinsed with deionized water to remove any attached sediment. In addition, each crab will be examined for damage to the carapace; crabs exhibiting extensive damage (i.e., cracks or holes) will be discarded.

2. Break off the chelipeds at the carapace and place claws aside for tissue removal. To dispatch the organism, lift the tail, place fingers into the body cavity of the crab and pull the top carapace off, exposing the internal organs.

3. Using a clean, decontaminated stainless steel spoon or knife, remove the internal organs (e.g., hepatopancreas).

4. Following removal of the organs, remove all soft tissue from the thoracic cavity, claws, legs, and abdomen portions of the crab using a clean, decontaminated stainless steel spoon or knife, placing it on a separate glass plate or metal sheet. The muscle tissue can be removed from the claws by breaking open the cheliped and scraping or pulling out all tissue. Residuals will be disposed of as described in SOP No. 13 - Management and Disposal of Residuals.

5. All obtainable soft tissues from the crabs, including the internal organs, will be combined as a composite. Samples will be transferred to the appropriate sample bottles, wrapped with bubble wrap, and placed into a labeled plastic bag.

6. Place the bag on ice in an insulated cooler, or in a freezer for storage until shipment.

7. Complete the appropriate Chain-of-Custody form for each sample container (SOP No. 3. Containers, Preservation, Handling, and Tracking of Samples for Analysis.

8. Ship sample in a cooler containing ice.

7.2 Sample Preservation

Specific instructions regarding sample preservation are described in SOP No. 3 - Containers, Preservation, Handling, and Tracking of Samples for Analysis.

8. Quality Control Samples

To help identify potential sources of sample contamination and evaluate potential error introduced by sample collection and handling, field quality control samples (QC samples) will be collected during the crab tissue sample collection and processing. All QC samples will be labeled in accordance with SOP No. 3- Containers, Preservation, Handling and Tracking of Samples for Analysis and sent to the laboratory with the other samples for analysis. QC samples for crab tissue collection will include rinsate samples, field duplicate samples, and matrix spike samples and will be collected or analyzed at the frequency specified in the SRIWP.

Figure 1 - Blue Crab Data Form

Project Number:_____ Sampling Date and Time:_____

SITE LOCATION

Site Name/Number:_____

County/Parish:_____ Lat./Long.:_____

Waterbody Name/Segment Number:_____

Waterbody Type: ☐ River ☐ Lake ☐ Estuary

Site Description:_____

_____

Collection Method:_____

Collector Name (print and sign):_____

Agency:_____ Phone:_____

Address:_____

SHELLFISH COLLECTED

Species Name:_____ Replicate Number:_____

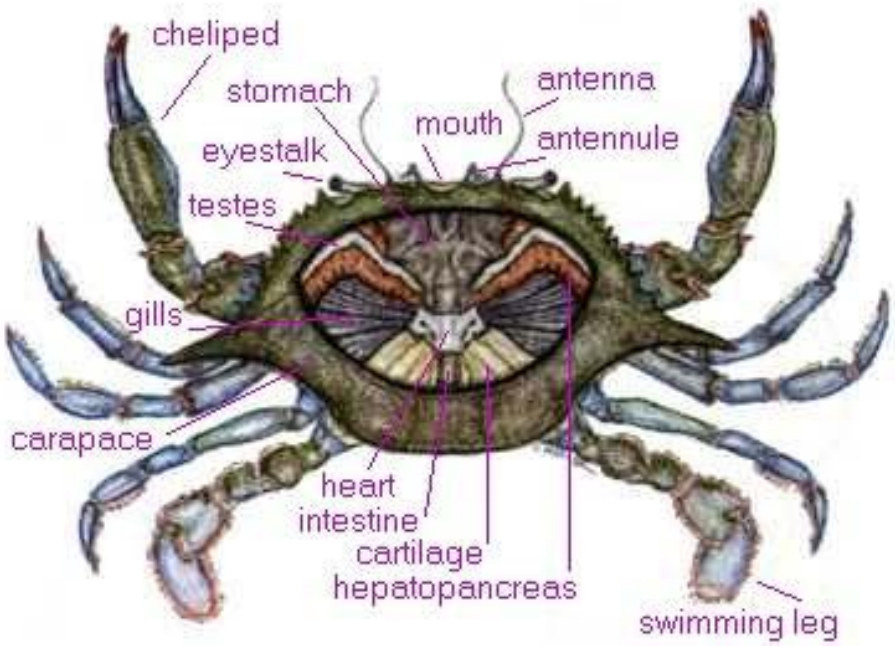
Composite Sample #:_____ Number of Individuals:_____

Shellfish #	Size (mm)	Sex	Shellfish #	Size (mm)	Sex	Shellfish #	Size (mm)	Sex
001			018			035		
002			019			036		
003			020			037		
004			021			038		
005			022			039		
006			023			040		
007			024			041		
008			025			042		
009			026			043		
010			027			044		
011			028			045		
012			029			046		
013			030			047		
014			031			048		
015			032			049		
016			033			050		
017			034					

$\frac{\text{Minimum Size}}{\text{Maximum Size}}$ X 100 = _____ ≥ 75% Composite Mean Size:_____(mm)

Notes (e.g. morphological anomolies):

Figure 2 - Anatomy of a Blue Crab



Source: Sea Grant Marine Advisory Program, Virginia Institute of Marine Science, College of William and Mary, 2006.

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Standard Operating Procedure No. 13

Management and Disposal of Residuals

January 2009

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for the disposal of sediment, water, personal protective equipment (PPE), and other potentially contaminated materials generated during Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP) operations.

This SOP provides procedures for handling potentially contaminated sediment, water, PPE, and other materials during coring and sampling activities through their ultimate disposal. Specific information regarding handling and disposal of residuals is provided in the SRIWP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modifications to this SOP will be approved in advance by the Facility Coordinator (FC) and the New Jersey Department of Environmental Protection (NJDEP) Site Manager. The ultimate procedure employed will be documented in the HRSA Supplemental Remedial Investigation Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Decontamination
- SOP No. 6 – Sediment Collection Using Hand Coring Device
- SOP No. 7 – Sediment Collection Using Vibracoring Device
- SOP No. 8 – Core Processing
- SOP No. 9 – Surface Sediment Sampling for Sediment Chemistry and Toxicity Tests
- SOP No. 10 – Benthic Invertebrate Community Sampling
- SOP No. 11 – Fish Tissue Sampling
- SOP No. 12 – Crab Tissue Sampling

2. Procedures

Potentially contaminated sediment, water, PPE, and other materials will be classified into three categories: (1) solid materials consisting of sediments, sediment samples returned from the laboratory, used polybutyrate core tubes, used PPE, and other materials used in the handling, processing, and storage of sediment (addressed in Section 2.2.1 of this SOP); (2) liquid wastes, such as wastewater, decontamination water, and aqueous samples returned from the laboratory (addressed in Section 2.3 of this SOP); and (3) spent and residual chemicals (liquids) from decontamination. Sediment from cores that is not processed for chemical or radiochemical analysis may be either archived or disposed of, and will be segregated and handled separately according to its classification. To the extent practical, liquids generated during coring and core processing operations should be separated from the solid material. Each type of material should be handled in the manner described in this SOP.

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- PPE or other safety equipment, as required by the SRIWP
- 55-gallon open-top drums (Department of Transportation [DOT] approved) with lid
- 30-gallon (minimum) garbage bags
- permanent marking pens and/or paint pens
- duct tape
- storage racks
- small (cooler-size) storage containers
- self-contained core storage facility
- walk-in cooler or refrigerated trailer
- chemical storage cabinet (meeting Occupational Safety and Health Administration and National Fire Protection Association Code 30 specifications/Factory Manual approved)

- logbook
- indelible ink pens

2.2 Solid Materials

2.2.1 Solid Residuals for Disposal

The remaining solid residuals generated during field activities will be sent for appropriate off-site disposal. These consist of two types of materials: non-sediment solid materials generated during the collection and processing of cores, including items, such as used polybutyrate core tubes, aluminum foil from clean core tubes, PPE (e.g., gloves, Tyvek® suits, boot covers), and sediment not used for analyses (e.g., waste sediment, such as that collected from the core "smear zone," and residual sediment). Non-sediment and sediment wastes will be segregated and temporarily stored in separate containers pending disposal. Loose sediment will be removed from non-sediment waste items prior to disposal and stored with other sediment wastes.

If recovered sediment is determined to be unusable after a core has been cut open, the sediment will be removed from the core tube and stored in an appropriate container for disposal as waste sediment. The used core tube will be stored and disposed of with the non-sediment solid wastes. Sediment residuals will be placed in 55-gallon drums, labeled, and stored temporarily until disposal in a manner approved by NJDEP.

Non-sediment solid materials will be placed in 55-gallon drums or bulk bags and stored temporarily until they can be disposed of in a manner approved by NJDEP. All drums and bags containing solids residuals will be labeled and handled as described in Section 2.4 of this SOP.

2.3 Liquid Wastes

2.3.1 Wastewater

Wastewater will be generated during sediment core processing and decontamination activities. Water mixed with detergent or chemicals will be drummed for disposal in a manner approved by NJDEP. Water from gross decontamination (e.g., from washing sediment from core tubes) will be allowed to stand so that the sediment settles; subsequently, the water will be decanted and drummed. Solids remaining after the water is decanted will be handled according to Section 2.2.1 of this SOP.

2.3.2 Chemical Liquid Wastes

Spent solvents, acids, and other residual chemicals generated during the decontamination process (SOP No. 2 – Decontamination) will be collected and stored in appropriate containers. These containers will be stored temporarily at the sediment processing area until recycling or disposal in a manner approved by NJDEP.

2.4 Handling and Tracking of Solid Materials and Containers

As they are generated during field activities, waste sediment and other solid waste materials will be placed in DOT-approved 55-gallon drums or 30-gallon bags on land at the end of the day. Solid waste materials, which are initially placed in bags, may be transferred into 55-gallon drums for storage. The following procedures will be followed for storing sediment and other solid waste in these drums:

1. A drum number will be assigned to each drum by the FC or designee. The drum number will be clearly marked on multiple places on the drum.

2. A log will be kept for each drum, listing the materials placed in that drum. All solid materials will be segregated based on the type of material (e.g., sediment, coring tubes, PPE, waste plastic, paper, or foil) and, to the extent practicable, by where they were generated (e.g., location within Hackensack River).

3. Drums will be closed or covered at the end of the day's work.

4. Collection drums may be reused at the processing facility after emptying.

5. Drums containing solid materials will be stored in a secured temporary facility until proper off-site disposal can be coordinated upon completion of the sampling event.

2.5 Handling and Tracking of Wastewater and Chemical Liquid Wastes and Containers

As they are generated during field activities, wastewater and chemical liquid wastes will be placed in separate DOT-approved 55-gallon drums on land at the end of the day. The following procedures will be followed for storing wastewater and chemical liquid wastes in these drums:

1. A separate drum will be used for each non-commingled chemical. Another separate drum will be used for chemicals and/or water that have been mixed.

2. A drum number will be assigned to each drum by the FC or designee. The drum number will be clearly marked on multiple places on the drum.

3. A log will be kept for each drum, listing the materials placed in that drum.

4. All drums will be closed or covered at the end of the day's work.

5. Collection drums may be reused at the Sample Processing Area after emptying.

6. Drums containing wastewater and chemical liquid wastes will be stored in a secured temporary facility until proper off-site disposal can be coordinated upon the completion of the sampling event.

3. Quality Assurance

Disposal procedures will be documented in a logbook to ensure that disposal activities are conducted in accordance with the procedures outlined in the SOPs. Waste manifests will be obtained for solid and aqueous waste disposal to verify that proper transportation and disposal of these materials has occurred.

4. Documentation

The FC or designee is responsible for documenting the handling and/or disposal of containers filled with solids or liquids generated during the SRIWP activities in accordance with SOP No. 1 – Field Documentation. In addition, the following information should be included in the logbook (at a minimum):

- name of person performing residual management or disposal activities
- date and time of activity
- information coordinating the container numbers for drums or bags containing solid materials with sample numbers, core boring numbers, or origin
- information coordinating the origin of waste liquid (water or chemical[s]) with the specific waste drum or tank

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Standard Operating Procedure No. 14

Tide Gage Installation

January 2009

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for installation of a tide gage as part of the Hackensack River Study Area (HRSA) Supplemental Remedial Investigation Work Plan (SRIWP). This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to install a tide gage.

This SOP may change depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Facility Coordinator and the New Jersey Department of Environmental Protection Site Manager. The ultimate procedure employed will be documented in the HRSA Supplemental Remedial Investigation Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation

2. Procedures

2.1 Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment and other safety equipment, as required by the SRIWP
- navigation charts (paper or digital)
- appropriate equipment and hardware for installing the tide gage (e.g., stilling well or equivalent device)
- tide gage
- logbook
- hardware to secure tide gage (e.g., wire ties, wood screws)

2.2 Installation Procedures

This section presents the general procedures for tide gage installation. Specific installation procedures will vary given the type of gage being installed, the location, and the structure to which the gage is being attached.

The tide gage will be a commercially available unit and will be installed according to the instructions provided by the manufacturer. A stilling well, or equivalent device, will be installed on the tide staff to minimize the effect of non-tidal water-level fluctuation (induced by boat traffic or winds) when reading the staff, if necessary.

Appropriate access authorization will be obtained prior to installing the tide gage to a bridge pier, bulkhead, or similar anchoring point. The gage will be secured to a bridge pier, bulkhead, or similar anchoring point so that the gage cannot be moved laterally or vertically. Following installation, the gage will be surveyed for vertical location from a third order benchmark or better (within 0.01 foot accuracy). The gage elevation will be established to 0.01 foot in the North American Vertical Datum of 1988 (NAVD88). Real-Time Kinematic Global Positioning System (RTK GPS) vertical techniques may be employed to establish the elevation of the tide gage staff in the event that a suitable local benchmark is not available. When employing RTK GPS techniques, the gage elevation will be established to an accuracy of 4 centimeters in NAVD88. The gage will also be surveyed for horizontal location (within 1 foot accuracy), established in the New Jersey State Plane Coordinate System, with respect to the North American Datum of 1983 (NAD83). In the event that the tide gage is installed in a location not visible to the GPS satellite constellation, then an approximate horizontal position will be reported.

3. Quality Assurance

Appropriate quality assurance/quality control procedures will be followed during surveying of each tide gage location and elevation, including the use of horizontal and vertical control points. The survey work will meet a minimum of third order vertical accuracy for the conventional traverse. A level loop and the closing error will be recorded, and benchmarks that are set will also be recorded. In addition, the following items will be checked during the installation process:

- security of the mounting system, eliminating the possibility of gage movement
- clock/time accuracy (referenced to Eastern Standard Time or Coordinate Universal Time)

- setting of a time-mark on the tide gage (e.g., noting the exact time in the logbook that tide gage is placed in the water)

4. Documentation

Field notes will be kept during installation activities in accordance with SOP No. 1 – Field Documentation. In addition, the following information should also be included in the logbook (at a minimum):

- date and time of installation
- location of the gage in New Jersey State Plane Coordinates (feet) and brief description of the vicinity
- specifications of gage
- installation method
- unusual conditions or problems with installation
- time that installation was completed
- vertical datum and control points

ELECTRONIC RECORD TARGET SHEET

SITE NAME:	**STANDARD CHLORINE**
CERCLIS ID:	**NJD002175057**
SDMS DOC ID:	**152361**
ALT. MEDIA TYPE:	
DOCUMENT FORMAT:	**CD / ELECTRONIC RECORD**
NATIVE FORMAT LOCATION/FILENAME:	**APPENDIX B CONTAINS CONFIDENTIAL AND PRORIETARY INFORMATION AND IS NOT RELEASABLE**
COMMENTS:	**FOR INFORMATION CONTACT THE SUPERFUND RECORDS CENTER, 290 BROADWAY, 18TH FLOOR, NYC 10007**

ELECTRONIC RECORD TARGET SHEET

SITE NAME:	**STANDARD CHLORINE**
CERCLIS ID:	**NJD002175057**
SDMS DOC ID:	**152362**
ALT. MEDIA TYPE:	
DOCUMENT FORMAT:	**CD / ELECTRONIC RECORD**
NATIVE FORMAT LOCATION/FILENAME:	**APPENDIX C CONTAINS CONFIDENTIAL AND PRORIETARY INFORMATION AND IS NOT RELEASABLE**
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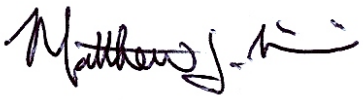
Peninsula Restoration Group

Environmental Health and Safety Plan (E-HASP)

Hackensack River Study Area

January 2009

ARCADIS



Matthew Nini
Designated Health and Safety Plan Writer

Charles Webster
Designated Health and Safety Plan Reviewer

Environmental Health and Safety Plan (E-HASP)

Hackensack River Study Area

Prepared for:
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Our Ref.:
B00099870000

Date:
January 2009

Table of Contents

Tables

Figures

Attachments

Acronyms

%	percent
ACGIH	American Conference of Governmental Industrial Hygienists
COC	constituent of concern
DOT	Department of Transportation
E-HASP	Environmental Health and Safety Plan
EAP	Emergency Action Plan
ft	feet
HARC	hazard analysis risk control
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HRSA	Hackensack River Study Area
HSO	Health and Safety Officer
JSA	job safety analysis
LEL	lower exposure limit
LPO	loss prevention observation
mllw	mean lower low water
mg/m^3	milligram per cubic meter
MSDS	material safety data sheet
NIOSH	National Institute for Occupational Safety and Health

OSHA	Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PEL	permissible exposure limit
PHSM	Project Health and Safety Manager
PPE	personal protective equipment
ppm	part per million
PRG	Peninsula Restoration Group
REL	recognized exposure limit
SSO	Site Safety Officer
TLV	threshold limit value

1. Introduction

All work on this project will be carried out in compliance with ARCADIS' health and safety policies and procedures, and the Occupational Safety and Health Administration's Hazardous Waste Operations and Emergency Response regulation 29 CFR 1910.120. The design of this Health and Safety Plan (HASP) conforms to the requirements of the ARC HSFS010 (HASP Health and Safety Procedure). Specific health and safety information for the project is contained in this E-HASP. All personnel working on hazardous operations or in the area of hazardous operations will read and be familiar with this E-HASP before doing any work. All project personnel will sign the certification page acknowledging that they have read and understand this E-HASP.

Changes in the scope of the project or introduction of new hazards to the project will require revision of the HASP by the HASP writer and reviewer and approval by the Project Manager (PM). The HASP Addendum Form and log table are included as Attachment A.

2. Project Site History and Requirements

2.1 Site Background

This Environmental HASP (E-HASP) has been prepared on behalf of Beazer East, Inc. (formerly known as Koppers Company, Inc.), Standard Chlorine Chemical Company, Inc., and Tierra Solutions, Inc. (formerly known as Maxus Energy Corporation) (collectively referred to as the Peninsula Restoration Group [PRG]). The Group is undertaking remedial activities in an area of The Hackensack River known as the Hackensack River Study Area (HSRA). The HRSA stretches from 0.5 mile upstream of the former Diamond Shamrock Site (Diamond Site), to 0.5 mile downstream of the former Koppers Seaboard Site (Seaboard Site). The Standard Chlorine Chemical Company, Inc. Site (SCCC Site) is located between the Diamond and Seaboard Sites. This area encompasses approximately 2.7 miles of the Hackensack River, the sediments from which may contain various chemicals including, but not limited to, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, pesticides, polychlorinated dibenzodioxins, polychlorinated dibenzofurans, and metals.

2.2 Site Description

Site Type: (Check as many as applicable}

X	Active		Secure	X	Industrial		Landfill		Service station
	Inactive	X	Unsecured		Commercial		Well field	X	Water work
		X	Uncontrolled		Residential		Railroad		Undeveloped
Other specify: Active, tidally influenced water way									

The HRSA encompasses one U.S. Army Corps of Engineers-defined navigation reach (Marion), along with a Turning Basin. According to the November 1997 National Oceanic and Atmospheric Administration navigation chart, the Marion Reach extends approximately 2.1 miles northeast from the terminus of Droyer's Point Reach to the Turning Basin. The navigation channel is approximately 300 feet (ft) wide, with depths 30 ft below Mean Lower Low Water (mllw). The Turning Basin extends approximately 1,215 ft northwest from the terminus of the Marion Reach. The Turning Basin ranges in width from 300 to 800 ft, with a depth 25 ft below mllw.

Areas not classified as a channel are identified as a side channel, a near-shore region, or a mudflat. The side channels neighbor the center channel, are constantly submerged, and have a depth up to 20 ft. The near-shore regions have a depth up to 6

ft and are tidally influenced, exposing some sections during low tide. These willow, near-shore regions are tidally influenced. The mudflats are areas along the shoreline that are approximately at the river water surface level and are also tidally influenced. These intertidal mudflats provide substrate for benthic organisms and foraging habitat for terrestrial animals. Twelve mudflats were identified within the HRSA during the Reconnaissance Program, ranging in both length and width.

2.3 List of Project Tasks and Scope of Work

- Vibracore sediment sampling
- Manual sediment/biota sampling
- Decontamination

Personnel will be performing the above tasks from boats, along the shore, on mudflats and/or on land. All work areas will be clearly marked and/or established as the Site Safety Officer (SSO) deems appropriate.

3. ARCADIS Organization and Responsibilities

3.1 Project Manager/Task Manager

In planning and preparation of this project, the project manager and/or task manager has completed the project-specific Health and Safety Stewardship Checklist and Project Hazard Analysis Worksheet. The project Hazard Analysis Worksheet was completed using the Hazard Analysis Risk Control (HARC) ranking process (ARCADIS Health and Safety Procedure ARC HSMS002) (see Section 4 of this E-HASP). Additional responsibilities of the project manager and task manager are as follows:

- Review all applicable health and safety procedures and ensure that project activities conform to all requirements.
- Obtain client-specific health and safety information and communicate with the client on health and safety issues.
- Communicate with the SSO on health and safety issues.
- Allocate resources to correct identified unsafe work conditions.
- Ensure ARCADIS site workers have all of the necessary training for the project.
- Report all injuries, illnesses, and near misses to the Client Health and Safety Resource or Project Health and Safety Manager (PHSM)
- Lead incident investigations and ensure that any recommendations made are implemented

3.2 Other Project Team Responsibilities

The additional personnel designated to carry out health and safety job functions for the project and their responsibilities are provided in Table 1 below. The same person may fill more than one role.

Table 1 – Roles and Responsibilities

ARCADIS Project Team	Responsibility and Tasks
Meredith Hayes	**SSO** • Reviews and works in accordance with the components of this E-HASP. • Ensures that this E-HASP is available to and reviewed by all site personnel including subcontractors. • Ensures that necessary site-specific training is performed (both initial and "tailgate" safety briefings. • Ensures site visitors have been informed of the hazards related to ARCADIS work, and have signed the Site Visitors Log. • Ensures that work is performed in a safe manner and has authority to stop work when necessary to protect workers and/or the public. • Coordinates activities during emergency situations. • Ensures that all necessary permits and safety information provided by the client is disseminated to other site personnel and is maintained in an organized manner. • Communicates with the PM, Client Health and Safety Resource and/or the PHSM on health and safety issues. • Reports all injuries, illnesses and near-misses to the PM, Client Health and Safety Resource and PHSM. • Ensures that necessary safety equipment is maintained and used at the site. • Contacts a health and safety professional for assistance in establishing the respiratory cartridge change schedule as required.
To Be Determined	**Site Workers** • Reads and works in accordance with the components of this E-HASP. • Reports all unsafe working conditions to the SSO. • Reports all injuries, no matter how minor, to the SSO. • Works in a safe manner. • Signs the HASP acceptance log in Attachment E.

Table 1 – Roles and Responsibilities (cont'd)

ARCADIS Project Team	Responsibility and Tasks
Chuck Webster	**Project Health and Safety Manager (PHSM)** The PHSM oversees all aspects of the site safety program, and prepares site-specific health and safety guidance documents or addenda to this plan. The PHSM does not report to the PM, and is separately accountable to the ARCADIS project team for site health and safety. The PHSM acts as the sole contact to regulatory agencies on matters of safety and health. Other responsibilities include: • Overall authority for health and safety compliance and HASP conformance for the project. • General health and safety program administration. • Conducts project health and safety audits as warranted. • Determines the level of personal protection required. • Updates equipment or procedures based on information obtained during site operations. • Establishes air-monitoring parameters based on expected contaminants. • Assists in injury, illness, and near-miss investigations and follow-up.
To Be Determined	**Client Health and Safety Resource** The designated Client health and safety Resource is responsible for : • Assisting the SSO in issues as they arise. • Performing site audits and assessments. • Assisting with near-miss/incident investigations. • Serves as the liaison with corporate during health and safety regulatory issues as they may arise.

4. Hazard Control

This section discusses the potential hazards related to project activities conducted at the PRG sites and the controls established to minimize those hazards. The figure below presents a risk assessment matrix for the consequences and likelihoods of risks associated with project activities conducted at the PRG sites. Additionally, the Hazard Analysis Worksheet is provided in Attachment B of this E-HASP.

Figure 1 - HARC- Risk Assessment Matrix (Health and Safety Procedure ARC HSMS002)

Risk Assessment Matrix		Likelihood Ratings**				
Consequences Ratings*		A	B	C	D	E
People	Property	Never heard of in the world	Heard of incident in industry	Incident has occurred in ARCADIS Group	Happens several times a year in ARCADIS OpCo	Happens several times a year at ARCADIS Worksite
0 - No health effect	0 - No damage	Low	Low	Low	Low	Low
1 - Slight health effect	1 - Slight damage	Low	Low	Low	Low	Low
2 - Minor health effect	2 - Minor damage	Low	Low	Low	Medium	Medium
3 - Major health effect	3 - Local damage	Low	Low	Medium	Medium	High
4 - PTD or 1 fatality	4 - Major damage	Low	Medium	Medium	High	High
5 - Multiple fatalities	5 - Extensive damage	Medium	Medium	High	High	High

4.1 Job Safety Analyses, TRACK, Health and Safety Procedures and Personal Protective Equipment

A Job Safety Analysis (JSA) has been completed for each safety-critical task that is relevant to the PRG sites; these are included in Attachment C. Hazards identified on the Project Hazard Analysis Worksheet are addressed in the JSAs, as well as control methods to protect employees and property from hazards. Each JSA also lists the type of personal protective equipment (PPE) required for the completion of the project. A detailed list of PPE for the project is located in Attachment D.

The following is of particular health and safety concern: If a Small Craft Warning is issued for a body of water adjacent to or near the HRSA, the vessel captain will utilize Stop Work Authority and return to shore. Further (as indicated in applicable JSA's), survival suits will be worn by all personnel working on, in, or near water when the water temperature is below 50 degrees Fahrenheit.

Hazards related to conducting work near the water, walking on soft and saturated sediment surfaces include falling, sinking, and getting stuck in the sediment. Any of these occurrences could cause exposure to impacted materials, drowning, and bodily injuries from unknown objects under the sediment surface.

Before starting a new task or when conditions change, utilize TRACK. Follow TRACK if you feel unsafe or unsure.

Think through the task

Recognize the hazards

Assess the risks

Control the hazards

Keep health and safety first in all things

ARCADIS health and safety procedures applicable to this project are listed below. These procedures should be reviewed by the project manager, task manager and site personnel. The Client Health and Safety Resource should be contacted with any questions concerning the procedures.

- ARC HSIH013 – Work Place Exposure Safety (Heat/Cold Stress)
- ARC HSFS002 – Boating Operations
- ARC HSFS011 – Hazardous Chemical Storage and Management

4.2 Field Health and Safety Handbook

The Field Health and Safety Handbook (Field H&S Handbook) is an ARCADIS document containing information about topic-specific health and safety requirements for the field. This handbook contains relevant general topics and is used as part of the overall HASP process. To aid in the consistency of the HASP process the handbook will be used as an informational source in conjunction with this E-HASP. The following four Field H&S Handbook sections are the minimal required reading for this project:

- Section III-F. General Housekeeping, Personal Hygiene and Field Sanitation

- Section III-G. Site Security, Work Zone and Decontamination for Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) Sites
- Section III-GG. HAZWOPER and HAZMAT Response
- Section III-II. Drums and other Material Handling

The following Field H&S Handbook sections are additional required reading for this project:

- Section III-I. Severe Weather
- Section III-M. Heat and Cold Stress
- Section III-N. Biological Hazards
- Section III-X. Boating Operations Safety
- Section V-G. Water Operations Work
- Section V-I. Industrial Hygiene and Monitoring Equipment

5. Hazard Communication

All project-required chemicals must be handled in accordance with the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.1200, ARCADIS-Hazard Communication Procedure (ARC HSGE007), and the requirements outlined in the Field H&S Handbook. Table 2 lists all chemicals that will be brought and stored on the site. Material safety data sheets (MSDS) for chemicals brought on site are included in Attachment E.

Table 2 – Master Chemical and Storage List

Chemical Name	Estimated Quantity	Chemical Storage Location
Nitric Acid (10% by volume)	10 Liters	ARCADIS Trailer or other location TBD by SSO
Methanol	10 Liters	ARCADIS Trailer or other location TBD by SSO
Hexane	10 Liters	ARCADIS Trailer or other location TBD by SSO

5.1 Chemical Hazards

Air monitoring will be conducted as outlined in this E-HASP to collect exposure data for constituents of concern (COCs) or for chemicals brought on site for use. Table 3 lists the properties of chemicals that will be encountered at the site.

Table 3 – Chemical Hazard Information

Substance (CAS Number)	IP (eV)	Odor Threshold (ppm)	Route	Symptoms of Exposure	Treatment	TWA	STEL	Source	IDLH (NIOSH)
Benzene [71-43-2]	9.24	34-119	Inh Abs Ing Con	Irritated eyes, nose, and respiratory system; dizziness; giddiness; headache; nausea; staggered gait; fatigue; anorexia, lassitude; dermatitis; bone marrow depression – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 ppm (0.5 ppm) NIC-0.1 skin 0.1 ppm	5 ppm 2.5 ppm 1 ppm	PEL TLV REL *OSHA 29 CFR 1910.1028	Ca (500 ppm)*
Chromium metal (as Cr) [7440-47-3]	NA	NA	Inh Ing Con	Histologic fibrosis of lungs;skin and eye irritation	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	1 mg/m^3 0.5 mg/m^3 0.5 mg/m^3		PEL TLV REL	250 mg/m^3
Chromium, Hexavalent [1333-82-0]	NA	?	Inh Ing Con	Irritated respiratory system; nasal septum perforation; liver and kidney damage, leukocytosis, leukopenia, eosinophilia, conjunctivitis, skin ulcer, sensitization dermatitis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.001 mg/m^3		REL	15 mg/m3
Coal-tar-pitch volatiles (benzene-soluble fraction) (PAH) [65996-93-2]	ND	ND	Ing Con	Eye sensitivity to light; eye and skin irritation, dermatitis, bronchitis; carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	0.2 mg/m^3 0.2 mg/m^3 0.1 mg/m^3		PEL TLV REL	Ca [80 mg/m^3]
Cyanides: calcium, potassium, and sodium [592-01-8; 151-50-8; 143-33-9]	NA	ND	Inh Abs Ing Con	Asphyxiation and death can occur; weakness, headache, and confusion; nausea and vomiting; increased respiratory rate; slow respiratory gasping; irritated eyes and skin	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	5 mg/m^3 5 mg/m^3 (skin)	C5 mg/m^3* C5 mg/m^3 *10 min	PEL TLV REL	25 mg/m^3

Table 3 – Chemical Hazard Information (cont'd)

Substance (CAS Number)	IP (eV)	Odor Threshold (ppm)	Route	Symptoms of Exposure	Treatment	TWA	STEL	Source	IDLH (NIOSH)
1,2-Dichlorobenzene [95-50-1]	9.06	12-300 mg/m3	Inh Abs Ing Con	Irritated eyes,nose, upper respiratory tract; liver and kidney damage; skin blisters; nausea, vomiting, diarrhea, anorexia, weight loss, jaundice and cirrhosis	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	25 ppm	C 50 ppm 50 ppm C50 ppm	PEL TLV REL	200 ppm
1,4-Dichlorobenzene [106-46-7]	8.98	0.18 ppm	Inh Abs Ing Con	Irritated eyes; periorbital swelling; profuse rhinitis; headache; anorexia, nausea, vomiting, jaundice	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	75 ppm 10 ppm Lowest feasible concentration		PEL TLV REL	Ca (150 ppm)
1,2,4-Tricholorobenzene [120-82-1]	NA	?	Inh Abs Ing Con	Irritated eyes, skin and mucous membranes. In animals: liver and kidney damage, possible teratogenic effects	Eye: Irrigate immediately Skin: Soap wash Breath: Respiratory support Swallow: Immediate medical attention		5 ppm 5 ppm	TLV REL	NA
Ethyl benzene [100-41-4]	8.76	0.09-0.6	Inh Ing Con	Irritated eyes, mucous membranes; headache; dermatitis; narcosis, coma	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	100 ppm 100 ppm 100 ppm	 125 ppm 125 ppm	PEL TLV REL	800 ppm
n-Hexane 110-54-3	10.18	65-248 ppm	Inh Abs Ing Con	Irritated eyes, nose; lightheaded; nausea, headache; numb extremities, muscular weakness; dermatitis; giddiness; chemical pneumonia (aspiration liquid)	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	500 ppm 50 ppm 50 ppm		PEL TLV REL	1100 ppm (LEL)

Table 3 – Chemical Hazard Information (cont'd)

Substance (CAS Number)	IP (eV)	Odor Threshold (ppm)	Route	Symptoms of Exposure	Treatment	TWA	STEL	Source	IDLH (NIOSH)
Methyl alcohol (Methanol) 67-56-1	10.84	4.2-5960 ppm	Inh Abs Ing Con	Irritation eyes, skin, upper respiratory system; headache, drowsiness, dizziness, nausea, vomiting; visual disturbance, optic nerve damage (blindness); dermatitis	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention	200 ppm 200 ppm 200 ppm	 250 ppm	PEL TLV REL	6000 ppm
Naphthalene [91-20-3]	8.12	0.0095-0.64 ppm	Inh Abs Ing Con	Irritated eyes; headache; confusion, excitement, malaise; nausea, vomiting, abdominal pain; irritated bladder, profuse sweating; jaundice, renal shutdown; dermatitis	Eye: Irrigate immediately Skin: Molten flush immediately/ sol-liq soap wash promptly Breath: Respiratory support Swallow: Immediate medical attention	10 ppm 10 ppm 10 ppm	 15 ppm 15 ppm	PEL TLV REL	250 ppm
Nitric Acid	11.95	?	Inh Ing Con	Irritated eyes, skin and mucous membranes; delayed pulmonary edema, pneumonitis, bronchitis, dental erosion	Eye: Irrigate immediately Skin: Water flush immediately Breath: Respiratory support Swallow: Immediate medical attention		2 ppm 2 ppm 2 ppm	PEL TLV REL	25 ppm
Polychlorinated biphenyls (PCB) Aroclor 1242 [53469-21-9] and Aroclor 1254 [11097-69-1]	ND	0.00083 ppm	Inh Abs Ing Con	Aroclor 1242: irritated eyes; chloracne; acne-form dermatitis; mildly toxic by ingestion; poison by subcutaneous route – carcinogenic Aroclor 1254: irritated eyes and skin; acne-form dermatitis; poison by intravenous route; moderately toxic by ingestion and intraperitoneal routes – carcinogenic	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Respiratory support Swallow: Immediate medical attention	Aroclor 1242: 1 mg/m^3 (skin) 1 mg/m^3 (skin) 0.001 mg/m^3 Aroclor 1254: 0.5 mg/m^3 (skin) 0.5 mg/m^3 (skin) 0.001 mg/m^3		 PEL TLV REL PEL TLV REL	 Ca (10 mg/m^3) Ca (5 mg/m^3)

Table 3 – Chemical Hazard Information (cont'd)

Substance (CAS Number)	IP (eV)	Odor Threshold (ppm)	Route	Symptoms of Exposure	Treatment	TWA	STEL	Source	IDLH (NIOSH)
Toluene	8.82	0.16-37	Inh	Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage	Eye: Irrigate immediately	200 ppm	C 300 ppm; 500ppm*	PEL	500 ppm
[108-88-3]			Abs		Skin: Soap wash immediately	20 ppm		TLV	
			Ing		Breath: Respiratory support	100 ppm	150 ppm	REL	
			Con		Swallow: Immediate medical attention		*10 min peak per 8hr shift		
Xylene (o-, m-, and p-isomers)	8.56	0.08-40 ppm	Inh	Dizziness, excitement, drowsiness, incoordination, staggering gait; irritated eyes, nose, throat; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eye: Irrigate immediately	100 ppm		PEL	900 ppm
[1330-20-7; 95-47-6; 108-38-3; 106-42-3]	8.56		Abs		Skin: Soap wash immediately	100 ppm	150 ppm	TLV	
	8.44		Ing		Breath: Respiratory support	100 ppm	150 ppm	REL	
			Con		Swallow: Immediate medical attention				

Notes:

Abs = absorption
Con = contact
IDLH = immediately Dangerous to Life and Health
Ing = ingestion
Inh = inhalation
NA = not applicable
ND = not detectable
PPM = part per million
STEL = short-term exposure limit
TLV = threshold limit value
TWA = time-weighted average

The threshold limit value (TLV) from the American Conference of Governmental Industrial Hygienists is listed unless the PEL (permissible exposure limit), designated by OSHA, is lower.

See Section 8 for information regarding air monitoring requirements.

6. Tailgate Meetings

Tailgate safety briefings will be conducted at least twice daily at the beginning of the work day, after a lunch break, and/or as tasks/hazards change. Each tailgate safety briefing will be documented on the form included in Attachment E.

7. Personal Exposure Monitoring

Personal and area exposure monitoring will be documented on the Real-Time Exposure Monitoring Data Form provided in Attachment E. All monitoring equipment will be maintained and calibrated in accordance with manufacturer's recommendations. All pertinent monitoring data will be logged on the form and maintained on site for the duration of project activities. Calibration of all monitoring equipment will be conducted daily and logged on the same form.

Table 4 lists exposure monitoring requirements and associated action levels for site exposure hazards.

Air monitoring will be conducted to determine employee exposure to airborne constituents. The monitoring results will dictate work procedures and the selection of PPE. The frequency for recording air monitoring results will be adjusted based on field readings in accordance with Table 4. The monitoring device to be used is a MultiRAE photoionization detector with an 11.7 eV lamp, oxygen, lower exposure limit (LEL), carbon monoxide, hydrogen sulfide sensors, or equivalent.

Table 4 – Exposure Monitoring Requirements

Parameter	Reading	Action
Total Hydrocarbons	0 to $\leq$ 0.5 parts per million (ppm)	Normal operations; continue hourly breathing-zone monitoring.
	> 0.5 to 25 ppm	Stop work; investigate cause of reading; Contact PHSM.
	> 25 ppm	Stop work; investigate cause of reading.
Benzene (Drager colorimetric tube)	$\geq$ 0.5 ppm to 10 ppm	Stop work; investigate cause of reading; Contact PHSM
Oxygen	$\leq$ 19.5%	Stop work, evacuate work area, investigate cause of reading, and ventilate area.
	> 19.5 to < 23.5%	Normal operations.
	$\geq$ 23.5%	Stop work, evacuate work area, investigate cause of reading, and ventilate area.

Table 4 – Exposure Monitoring Requirements (cont'd)

Parameter	Reading	Action
Carbon Monoxide	0 to ≤ 20 ppm > 20 ppm	Normal operations. Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area.
Hydrogen Sulfide	0 to ≤ 5 ppm > 5 ppm	Normal operations. Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area.
Flammable Vapors (LEL)	< 10% LEL ≥ 10% LEL	Normal operations. Stop work, ventilate area, investigate source of vapors.
Excessive Noise from various equipment	Normal conversation and listening levels at a distance of 1 m between personnel Inhibited or strained conversation and/or hearing	Normal operations. Don hearing PPE – ear plugs or ear muffs will be used; individual preference will determine type of hearing PPE

8. Medical Surveillance

Medical surveillance requirements for the project are provided on the Project Manager/Task Manager Health and Safety Stewardship Checklist and Project Hazard Analysis Worksheet (Attachment B). All medical surveillance requirements as indicated on the worksheet must be completed and site personnel medically cleared before being permitted on the project site.

9. General Site Access and Control

The SSO will coordinate access and control security at the work site. As the work dictates, the SSO will establish a work area perimeter. The size of the perimeter will be based on the daily task activities and will be discussed with all project personnel during the tailgate meeting and then documented on the tailgate meeting form. Control zones for Level C or above will be demarcated by either visual or physical devices and will be monitored for effectiveness by the SSO.

Only authorized personnel will be allowed beyond the perimeter. Other site workers and visitors to the site should be kept out of the work site. If visitors need access to the site, the SSO will escort the visitor at all times. All visitors will log in and out with the SSO. The visitor log sheet is included in Attachment E.

10. Decontamination Control Zones and Procedures

Part of required reading for this E-HASP includes reviewing the Field H&S Handbook, Section III-G Site Security, Work Zones and Decontamination for HAZWOPER site zones. The decontamination procedures outlined in the Field H&S Handbook are provided for typical Level D and Level C ensembles.

The zones for Level C and above will be designated by traffic cones, barricades, signs, caution tape, or other means effective in identifying the different areas. The SSO will establish control boundaries for the exclusion zone, contamination reduction zone, and the support zone. The zones will be identified by the SSO during tailgate meetings and documented on the meeting form. Entrance and exit to the exclusion zone will only be through controlled access points established for each work area.

11. Emergency Action Plan

In the event that an injury, over-exposure or spill has occurred, an Emergency Action Plan (EAP) will be implemented. Attachment F provides the EAP and notifications for the project. All employees working on this project must be shown the location and proper use of all emergency equipment prior to beginning work on the project.

12. Department of Transportation Dangerous Goods Shipping Requirements

ARCADIS has policies in place for transporting small quantities of hazardous materials and for offering shipping of these materials via ground or air. These policies are designed to meet the applicable Department of Transportation (DOT) requirements. As such, only ARCADIS staff trained in the proper methods to prepare and ship hazardous materials are authorized to do so. Tasks associated with the packaging, labeling, marking, and preparation of hazardous materials for shipping or transport must have all appropriate and applicable training.

12.1 Materials of Trade

The DOT allows for a small amount of hazardous materials that are used in or an inherent part of our work to be transported in company vehicles. This includes things like gasoline, paint, small compressed gas cylinders, calibration gas, etc. To transport these:

- Staff will complete Materials of Trade training.
- Vehicles used in transportation to and from off-site work locations will be in conformance with ARCADIS vehicle safety procedures.

Hazardous materials will be transported as described above as a result of the activities covered in this E-HASP. Site personnel who transport materials mentioned above will complete the Hazardous Materials Transportation Form included in Attachment E.

12.2 Department of Transportation

Staff who collect, prepare, package, mark, label, complete shipping declarations, offer shipments to a transporter, directly transport or are engaged in other activities associated with the transportation of Hazardous Materials (referred to as Dangerous Goods in Canada and by the International Air Transport Association will have appropriate and applicable training. DOT requires all individuals who participate in hazmat shipping including activities such as completing the paperwork (but not signing it), filling a container with a hazardous material (including filling a drum with drill cuttings or purge water), marking, labeling, and packaging the hazardous material, etc., have awareness level training on the DOT requirements. DOT requires additional job function training for those who conduct specific activities including:

- Staff that have to sign shipping papers or manifests are listed as the 24-hour emergency contacts on shipping and are responsible for identifying, classifying, packaging, marking, and labeling Hazardous Material packages. These staff are also responsible for directing or overseeing others who do these tasks and who will become certified through the completion of additional training.

- The above training allows the offering employee to ship only by ground. If the shipment is to be offered for air transport, additional training is required.

Shipments as described above will be made as a result of the activities covered in this E-HASP. Site personnel shipping hazardous materials will complete the Hazardous Materials Shipment Form included in Attachment E.

13. Loss Prevention System™ and Loss Prevention Observations

As part of any project, no matter how simple or complex, loss prevention observations (LPOs) should be conducted when practical and when able to integrate into normal business activities. LPOs should be scheduled based on the risk of the tasks being performed, and should be conducted for different tasks and at different times. Completion of LPOs should be documented on the tailgate meeting form.

The table below outlines the LPO plan for the project.

Table 5 – Example LPO Plan

Identified Task for LPO	Schedule Date	Observer Name	Observee Name	Feedback Supervisor Name
All field tasks	One per 60 team hours (approximate)	TBD	TBD	Alain Hebert and/or Meredith Hayes

14. Subcontractors

A copy of this E-HASP is to be provided to all subcontractors prior to the start of work so that the subcontractor is informed of the hazards at the site. The ARCADIS HASP is the minimum health and safety requirements for the work completed by ARCADIS and its subcontractors. Additionally, each subcontractor, in coordination with ARCADIS health and safety personnel, is expected to perform operations in accordance with its own HASP, policies, and procedures unique to the subcontractor's work to ensure that hazards associated with performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to ARCADIS for review prior to the start of on-site activities.

In the event that the subcontractor's procedures/requirements conflict with requirements specified in this E-HASP, the more stringent guidance will be adopted after discussion and agreement between the subcontractor and ARCADIS project health and safety personnel. Hazards not listed in this E-HASP, but known to the subcontractor or known to be associated with the subcontractor's services, must be identified and addressed to the ARCADIS project or task manager and SSO prior to beginning work operations.

If the subcontractor prefers to adopt this E-HASP, the **"Subcontractor Acknowledgement Memo" must be signed and dated by the subcontractor's management and placed in the project file.** Once the signed memo is received by the project manager, an electronic version of our HASP can be submitted to the subcontractor to use as their own. Subcontractors working at the site will need to have this plan with them, and will also need to sign the Subcontractor HASP receipt signature page of the ARCADIS HASP (Attachment E). Subcontractors are responsible for the health and safety of their employees at all times and have the authority to halt work if unsafe conditions arise.

The Project/Task Manager and SSO (or authorized representative) has the authority to halt the subcontractor's operations and to remove the subcontractor or subcontractor's employee(s) from the site for failure to comply with established health and safety procedures or for operating in an unsafe manner.

15. Project Personnel HASP Certification

All site project personnel will sign the certification signature page provided in Attachment E of this E-HASP.

ARCADIS

Attachment A

HASP Addendum Pages and Log Table

ARCADIS

Addendum Page

This form should be completed for new tasks associated with the project. The project manager and/or task manager should revise the Project Hazard Analysis Worksheet with the new task information and attach to this addendum sheet. JSAs should be developed for any new tasks and attached as well.

Review the addendum with all site staff, including subcontractors, during the daily tailgate briefing, and complete the tailgate briefing form as required. Attach a copy of the addendum to all copies of the HASP including the site copy, and log in the Addendum Log Table A-1 on the next page.

Addendum Number: _____ Project Number: _____

Date of Changed Conditions: _____ Date of Addendum: _____

Description of Change that Results in Modifications to HASP:

Signed: _____ Signed: _____
Project Manager Site Safety Officer

Signed: _____ Signed: _____
Health and Safety Plan Writer Health and Safety Plan Reviewer

ARCADIS

Addendum Log Table

Addendums are to be added to every copy of the HASP, and logged on Table A-1 to verify that all copies of the HASP are current:

Table A-1 Addendum Log Table

Addendum Number	Date of Addendum	Reason for Addendum	Person Completing Addendum
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Make additional copies of this form as necessary.

ARCADIS

Attachment B

Project Hazard Analysis Worksheet

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Proposal Development Page

Project Name:	**Hackensack River Study Area**		**Project/Proposal Number:**	**B0009987.0000.00023**	
Client:	**Peninsula Restoration Group**		**Principal-In Charge:**	**Bob Romagnoli**	
Project / Task Manager:	**Alain Hebert/Meredith Hayes**	**Completed By:**	**Meredith Hayes**	**Date:**	**5-Jan-09**

Proposal Development (check each item Y/N when completed)	**Y or N Provide explanation if N** **(all boxes must be completed)**
1. Consider H&S in Go/No Go process	
a. Are the H&S responsibilities/requirements for the project clearly defined?	
b. Have Legal and H&S (Client H&S resource needs to be on RFP distribution) reviewed project H&S risks?	
c. Can H&S risks be appropriately mitigated? (Use Tab 4 to help do a quick analysis of the hazards and control processes)	
d. Can ARCADIS meet client's H&S criteria for this contract?	
e. Is client willing to pay for H&S requirements?	
f. Is additional training required for staff? (Consult H&S or ARCHIMEDES for assistance.)	
2. Understanding of client and project H&S requirements	
a. Is field work included?	
b. Does client have specific H&S requirements? (Your client team H&S resources can assist with this)	
c. What contractual H&S responsibilities do we have; ARCADIS employees only, our subs, client's contractors, client's personnel, general public, others?	
3. Include H&S in the project proposal development and cost estimation	
a. Have the H&S tasks been adequately scoped?	
b. Are the H&S tasks adequately budgeted (See Tab 5 - Planning and Budgeting)?	
c. Has the Client H&S resource or other H&S staff member approved the H&S tasks scope and budgets?	
d. Have periodic H&S audit(s) been budgeted (See Tab 5 - Planning and Budgeting)?	
e. Is a H&S scope or a disclamer for clients or projects that have no specific H&S requirements needed in the proposal or contract documents?	

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project Tasks List Page

Project Name:	**Hackensack River Study Area**		**Project Number:**	**B0009987.0000.00023**	
Client:	**Peninsula Restoration Group**		**Principal-In Charge:**	**Bob Romagnoli**	
Project / Task Manager:	**Hebert/Meredith Hayes**	**Completed By:**	**Meredith Hayes**	**Date:**	**5-Jan-09**

Project Hazard Analysis Worksheet

TRACK

Think through the Tasks: List all tasks associated with project:	
1	Vibracore sediment sampling
2	Manual sediment sampling
3	Biota sampling
4	Sample processing
5	
6	
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20	

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project Hazard Analysis Page

Project Name:	**Hackensack River Study Area**		**Project Number:**	**B0009987.0000.00023**	
Client:	**Peninsula Restoration Group**		**Principal-In Charge:**	**Bob Romagnoli**	
Project / Task Manager:	**Hebert/Meredith Hayes**	**Completed By:**	**Meredith Hayes**	**Date:**	**5-Jan-09**

ARCADIS Project Hazard Analysis Worksheet

TRACK

Recognize and Assess the Hazards for the Project

For each potential hazard, determine the worst case conditions for the entire project and all of the tasks and assess them using High (H), Medium (M), Low (L). Use the drop down list in each "Assess" cell. If a hazard is not expected on the site, leave the "Assess" box blank.

	Recognize the Hazards	Assess	Recognize the Hazards	Assess	List Types of other Physical Hazards Below
Physical Hazards:	Heat	Medium	Holes/Pits		
	Cold	High	Ionizing Radiation		
	Noise	Low	Non-ionizing Radiation		
	Walking/Working surfaces (includes slip/trip/fall & floor/wall openings)	Medium	Electricity		
	Visible Dust		Poor lighting		
	LASER		Severe Weather	High	
	Other: Water hazards	High	Overhead Hazards		
	Other:		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Appropriate rest/work time intervals will be used to combat cold/heat stress. Survival suits will be worn when water temps are below 50 degrees F and work is conducted on or adjacent to the water. Local weather reports will be monitored to address potentially severe weather. Walkways and intended paths will be surveyed prior to movement.

Chemical Hazards:	Flammable/ Combustible		Corrosive	Medium	**List the Names of the Major Chemicals Below**
	Compressed gas		Toxic	Medium	VOCs, SVOCs, P/PCBs
	Explosive		Highly toxic	Low	Chlorinated herbicides
	Organic peroxide		Irritant	Medium	TAL metals, cyanide
	Oxidizer		Sensitizer	Low	TEPH, PCDDs/DFs
	Water reactive		Carcinogen	Medium	Hexavalent chromium
	Unstable reactive		Mutagen		
	Dust/Fumes/ Particulates	Medium	None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Appropriate PPE and breathing zone monitoring will be utilized. PPE includes but is not limited to: task specific gloves, survival suits, coveralls, safety shoes, hard hats, safety glasses and hearing protection. If protection beyond level D is required, work will stop and the PM/PSHM will be contacted.

Environmental/ Equipment Hazards:	Heavy machinery	Medium	Cranes/Hoists/Rigging		**List Types of Other Environmental / Equipment Hazards Below**
	Trenching/excavation		Ladders		
	Docks – marine operations	Medium	Scaffolding		
	Construction activities		Manlifts		
	Diving operations		Welding		
	Drilling		Gas cylinders		
	Forklifts		Roadway work		
	Water operations work	Medium	Railroad work		
	Heights (fall protection)		Mining work		
	Overhead/ Underground utilities	Medium	Energized / Pressurized equip (LO/TO)		
	Confined spaces		Drums and containers	Low	
	Power tools		Other		
	Other		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Applicable JSAs will be reviewed, edited and/or created based upon observed environmental and equipment hazards. The buddy system and environmental/equipment specific PPE will be reviewed and utilized as necessary.

Biological Hazards	Animal/Human fluids or blood	Low	Contaminated Needles		**List Types of Other Biological Hazards Below**
	Animal/Human tissue(s)	Low	Live Bacterial Cultures		
	Poisonous/irritating plants	Low	Insects/rodents/snakes	Low	
	Other:		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Task specific gloves, appropriate attire and PPE will be worn. This includes but is not limited to: long pants/sleeves, coveralls, safety glasses, face shield, nitrile/leather/kevlar gloves.

Ergonomic Hazards	Repetitive motion	**Low**	Limited movement		**List Types of Other Ergonomic Hazards Below**
	Awkward position	**Low**	Forceful exertions	**Low**	
	Heavy lifting	**Low**	Vibration	**Low**	
	Frequent lifting	**Low**	Other:		
	Other:		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Proper ergonomics including but not limited to lifting, carrying, pushing and pulling techniques will be addressed and reinforced by JSAs and LPOs.

Personal Safety/Security	Personal safety		Employees working early/late	**Low**	**List Types of Other Personal Safety / Security Hazards Below**
	Security issue		Potentially dangerous wildlife	**Low**	
	Project site in isolated area		Guard or stray dogs in area		
	Employees working alone		No/limited cell phone service		
	Fatigue		Other:		
	Other		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Task specific gloves, appropriate attire and PPE will be worn to protect against dangerous flora/fauna. This includes but is not limited to: long pants/sleeves, coveralls, safety glasses, face shield and nitrile/leather/kevlar gloves. Very early/late work will attempt to be avoided as much as possible by effective prior planning.

Driving Safety	Driving early/late	**Low**	City driving		**List Types of Other Driving Hazards Below**
	Driving long trips		Pulling a trailer		
	Driving off-road		ATV driving:		
	Bad weather driving		Other		
	Other		None: Mark with an "X"		

Control the Hazard: (Briefly describe how the identified hazards will be controlled)

Driving early/late will attempt to be avoided as much as possible by effective prior planning.

Training Required	40 hour HAZWOPER	**Yes**	Bloodborne pathogens		**List Types of Other Training Required Here**
	24 hour HAZWOPER		Confined space		
	HAZWOPER site supervisor		Lockout/tagout		
	OSHA 30 hour Construction		Electrical Safety		
	OSHA 10 hour Construction		Fire Extinguishers		
	PPE	**Yes**	Fall Protection		
	Respiratory protection	**Yes**	Noise exposure		
	Chemical hygiene		Forklifts		
	Hazard communication		Asbestos		
	Hazardous waste		Lead		
	First-aid/CPR	**Yes**	Cadmium		
	DOT/IATA hazmat transportation	**Yes**	SPCC		
	MSHA		Radiation safety		
	Diving		Client specific		
	FRA		None: Mark with an "X"		
Medical Screening	Medical Surveillance Exam (HAZWOPER)	**Yes**	Other hazardous substance		**List Types of other Medical Screening Here**
	Pulmonary Function Test if wearing respirator and employee not part of HAZWOPER	**Yes**	Audiometric test if noise is a hazard and employee not part of HAZWOPER		
	Client required drug and/or alcohol testing		Blood and/or urine screening		
	Hepatitis B Immunization (or declination on file)		None: Mark with an "X"		

Keep Safety First In All Things

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project Planning & Budgeting Page

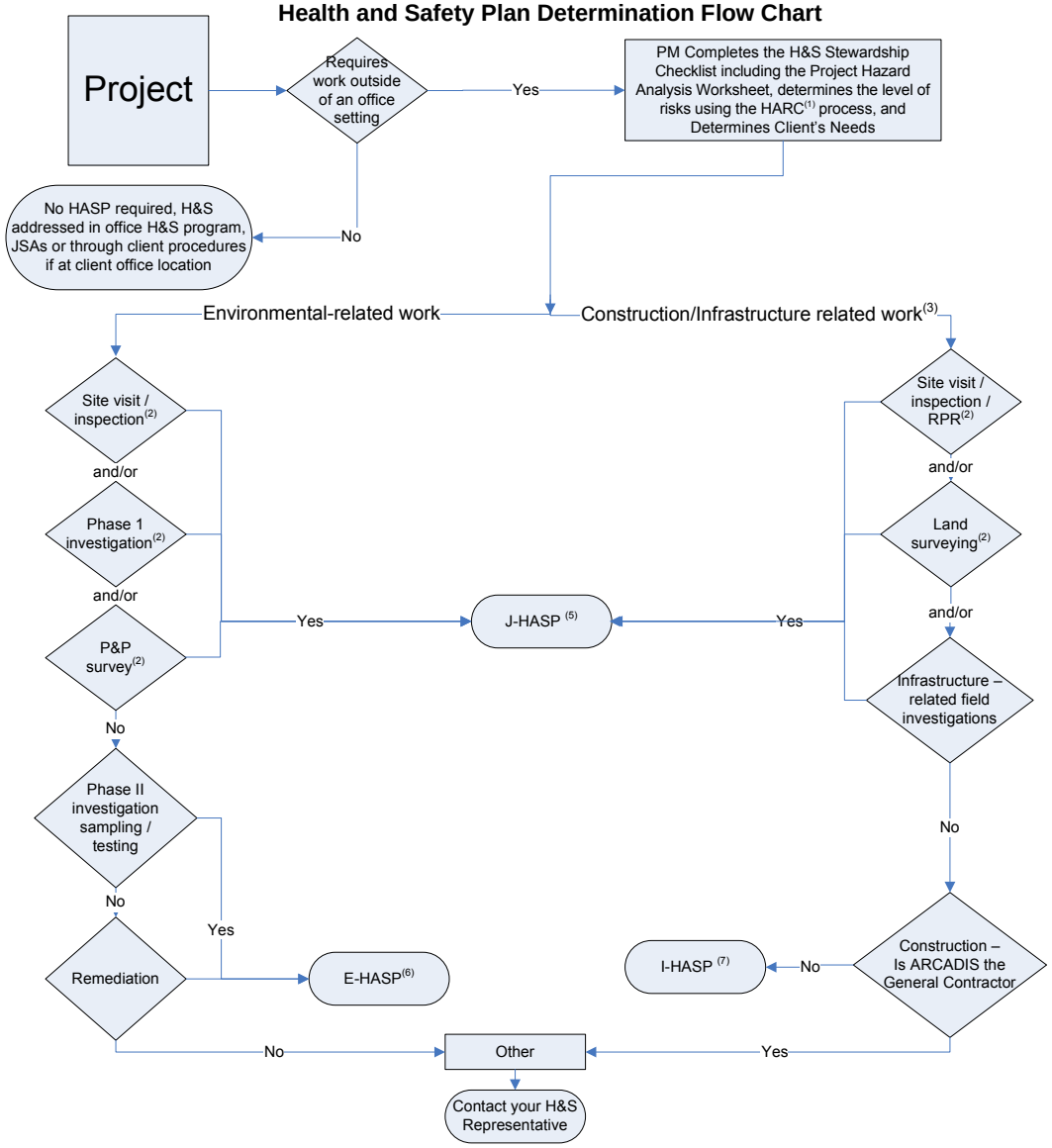
Project Name:	**Hackensack River Study Area**		**Project Number:**	**B0009987.0000.00023**	
Client:	**Peninsula Restoration Group**		**Principal-In Charge:**	**Bob Romagnoli**	
Project / Task Manager:	**Alain Hebert/Meredith Hayes**	**Completed By:**	**Meredith Hayes**	**Date:**	**6-Jan-09**

Project Planning and Budgeting (check each item Y/N when completed)	**Y or N Provide explanation if N** (all boxes must be completed)
1. Complete project hazard analysis form (Tab 4)	
a. Identify Client Team H&S resource and job experts to complete Tab 4 - Hazard Analysis on project	Y
b. Determine controls that will be necessary to eliminate or minimize the hazards	Y
2. Project staffing	
a. Have you contacted and involved the Client Team H&S resource (if assigned)?	Y
b. Is a project H&S resource identified for the project?	Y
c. Does the project need a full-time or partial time H&S coverage from the H&S group? (Click on note (red triangle in corner) in adjacent cell and work with your Client H&S Resource for assistance).	Y (part-time)
d. Has qualified staff been identified for the project based on scope and hazards?	Y
e. Has planned staff been appropriately trained based on the hazards to be encountered, client requirements, type of project and ARCADIS requirements?	Y
f. Have planned staff been medically cleared and/or cleared substance abuse screening to do the work per regulatory, client, and ARCADIS requirements?	Y
g. If airborne chemical(s) or particulate matter may be encountered requiring respiratory protection, has the planned project staff been appropriately medically cleared, fit-tested, and trained for respirator use?	N/A
3. Project subcontractors	
a. Have subcontractors been qualified from a H&S standpoint per ARCADIS and client criteria?	Y
b. Have selected subcontractors been notified of H&S responsibilities and are these responsibilities included in the subcontract?	N- subcontract will not be implemented until agency approval of workplan, subcontractor used before on similar project
c. Have selected subcontractors been notified of client H&S requirements and are these requirements included in the subcontract?	N
d. Have selected subcontractors submitted their H&S plans and documents?	N
4. Project H&S Budgeting	
a. Is there adequate budget for H&S tasks including H&S plan development, H&S orientation, special training, tailgate meetings, assessments, H&S resource visits, H&S conformance assessment, daily inspections, etc.? (Enlist assistance of H&S resources to develop budgets)	Y
i. From the dropdown list in the next cell, select a level of HASP that applies to this project from the HASP decision flowchart (Select J-HASP, I-HASP, or E-HASP) See HASP determination flowchart in Tab 5a.	E-HASP
ii. Estimated H&S staff hours for HASP development (Consult with Client H&S Resource for final determination of hours)	16 to 40 hrs
iii. Estimated H&S staff hours for HASP review (Consult with Client H&S Resource for final final determination of hours)	2 to 4 hrs
iv. Estimated H&S staff hours for site visits and assessments (Copnsult with Client H&S Resource for final determination of hours)	4 to 8 hrs per month of field activities duration
v. Estimated H&S staff hours for other H&S support (Consult with Client H&S Resource for final determination of hours)	See Client Team H&S Resource
b. Budgeted for H&S equipment including PPE, air monitoring, ventilation systems, rescue equipment, fire prevention, first aid kits, etc.? The TPPT has a list of these charges. (Enlist assistance of H&S resources to determine the proper equipment necessary for the job)	N- cost estimate for implementation of work not yet submitted to client
5. Project H&S Plan and Job Safety Analysis Development and Review	
a. Have designated and approved HASP writers and job experts been identified to develop HASP and appropriate JSAs?	Y
b. Have appropriate reviewers been determined and notified?	Y
c. Has adequate time been allocated for the development of such documents?	Y
d. Have the documents been completed, reviewed, and approved?	Y
e. Based on tasks & hazards, has an job safety observation schedule been established and documented in the HASP?	Y
f. Have H&S plans and processes for the project been coordinated with subcontractors and the client?	Y

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project HASP Determination Flow Chart Page

Health and Safety Plan Determination Flow Chart



Abbreviations:
CHSHB – Construction Health and Safety Handbook
EAP – Emergency Action Plan
EP&P – Environmental Planning and Permitting
FHSHB(4)– Field Health and Safety Handbook
HARC – Hazard Assessment and Risk Control
HASP – Health & Safety Plan
HAZWOPER – Hazardous Waste Site Operations and Emergency Response
JSA – Job Safety Analysis
RPR – Resident Project Representative

Rev. 1 4/2008

Footnotes:
(1) – **All projects** must have gone through the HARC process of determining level of risks (if any) and the subsequent control determination at the onset of developing work plans.
(2) – Tasks performed in a HAZWOPER Exclusion Zone require preparation of a HASP as defined by OSHA 29 CFR 1910.120 using the Environmental template as footed by (6).
(3) – If any Infrastructure Division work involves work on Environmental Division project sites, then the Environmental Division branch of this flow chart must be followed.
(4) – **All HASPs** may utilize the FHSHB for generic H&S requirements. Those referenced FHSHB sections must be identified in the HASP (except those that are footnoted as (5).
(5) – A HASP document consisting of at least the following elements (called an J-HASP in ARC HSFS010):
- Hazard Analysis Worksheet
- One or more JSAs specific to the job at hand
- An EAP
- A Tailgate Safety Meeting Form
- Other ARCADIS H&S documents as appropriate (i.e., SOPs, Material Safety Data Sheets, client information) and Employee/Subcontractor Sign-in sheets for tailgate meeting attendance

(6) – A HASP as defined by OSHA 29 CFR 1910.120 HAZWOPER Standard using the Environmental template or client required format (called an E-HASP in ARC HSFS010).
(7) – A HASP following the non-environmental template (called an I-HASP in ARC HSFS010).

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project Start-Up, Execution, and Close-Out Page

Project Name:	**Hackensack River Study Area**		**Project Number:**	**B0009987.0000.00023**	
Client:	**Peninsula Restoration Group**		**Principal-In Charge:**	**Bob Romagnoli**	
Project / Task Manager:	**Hebert/Meredith Hayes**	**Completed By:**		**Date:**	

Project Start-Up (check each item Y/N when completed)	**Y or N Provide explanation if N (all boxes must be completed)**
1. Arrange with client for project and site H&S orientation and complete session for all staff and subcontractors	
a. Review HASP and associated JSAs	
b. Review emergency response procedures	
c. Review site requirements	
d. Are there other activities being conducted at the client's or adjacent sites that may pose hazards to staff and subs	
e. Have all staff sign HASP	
2. Ensure prescribed H&S equipment is acquired and on-site	
3. Plan safety observations and field verification and validation activities for project	
Project Execution (check each item Y/N when completed)	
1. Periodically make site visits	
a. Conduct tailgate safety meetings	
b. Ask about TRACK and how the staff used it that day	
c. Conduct preplanned safety observations	
d. Do field verification and validation assessments of safety observations, JSAs, Incident Investigations	
e. Observe activities to ensure activities are they being done according to HASP and JSAs, and safely in general	
f. Ensure that HASP and JSAs are periodically reviewed and updated as necessary	
g. Ensure effective tailgate meetings are being conducted	
h. Ensure PPE is being appropriately replenished	
i. Recognize staff for strong H&S performance, behavior, etc.	
2. Arrive on-site prepared	
a. Review HASP and JSAs prior to arriving	
b. Have appropriate PPE including at a minimum	
i. Hard hat	
ii. Class II traffic safety vest	
iii. Work boots including steel toes as required	
iv. Safety glasses	
v. Hearing protection	
vi. Other PPE as required by HASP	
Project Closeout (check each itemY/N when completed)	
1. Review H&S performance and determine lessons learned to apply to future projects	
2. Document lessons learned to PMO (refer to Tab 7)	
3. Ensure all H&S-related documentation is placed in project files	

ARCADIS US Project Manager and Task Manager/Principal-In-Charge H&S Stewardship Checklist

Project Lessons Learned Page

Project Name:	Hackensack River Study Area		Project Number:	B0009987.0000.00023	
Client:	Peninsula Restoration Group		Principal-In Charge:	Bob Romagnoli	
Project / Task Manager:	Hebert/Meredith Hayes	Completed By:		Date:	

List Lessons Learned and Best Practices Below	Should it Be Shared with Others

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Attachment C

JSAs

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JOB SAFETY ANALYSIS

SECTION 1	
JSA Type:	Aquatic Investigations
JSA No:	JSA002229
Date:	12/18/2008
Work Type:	Aquatic Inv - Sediment Core Processing
Work Activity:	Vibracore Processing and Sampling
Project No.:	B00099870000 - HACKENSACK RIVER (HACKENSACK RIVER)

SECTION 2

Development Team	Position / Title	PC	Reviewed By	Position / Title	Date
Nini, Matthew J.		☑	Hayes, Meredith K.		1/5/2009
			Hebert, Alain P.		1/14/2009
			Larew, Scott M.		1/5/2009

SECTION 3

Job Steps	Potential Hazard(s)	Critical Action(s)	SOP Reference
Transport core to specific work area.	Heavy lifting, strains, sprains, pinch points, repetitive motion.	Lift with legs, avoid bending and awkward postures; use two person lift. Use work gloves. Survey area and intended path of travel prior to lifting and moving. Rotate among staff to the extent possible.	
Drain cores - cut caps and tip core.	Cuts, scrapes, splashing liquid.	Secure core on designated core processing table. Use battery powered shears or geoprobe-style tube cutter and wear kevlar gloves. Cut away from body and limbs. Be aware of all body parts and other people in relation to intended path of blade during cutting. Pour core liquid into appropriate container.	
Cut top of core with pipe cutter.	Cuts, scrapes, pinch points.	Use a sharp blade and smooth motion. Avoid pinch points.	
Shear core.	Cuts, scrapes, pinch points, electrical hazards, vibration.	Maintain blade; cut away from body and limbs; wear kevlar gloves. Be aware of all body parts, power cord and other people in relation to intended path of blade during cutting. Keep table and cutting area in powerzone aka wheelhouse. Use GFCI equipment. Use buddy system: one person to hold/stabilize the core, one person to cut. Do not hold core in the line of intended cutting, hold behind the blade when possible and only when necessary; use blocks/vises on processing table as much as possible.	
Inspect sediment for characterization.	Cross or self contamination.	Use nitrile gloves, wear apron or body suit, avoid excessive contact with media. Maintain good housekeeping.	
Collect sample by scooping	Repetitive motion, cross or	Design work areas and use tools that promote proper ergonomics. Use tables and other mechanical aides as necessary. Use	

sediment.	self contamination.	dedicated and disposable or decontaminated sampling equipment. Rotate staff to the extent possible.	
Data Entry.	Repetitive motion.	Design work areas and use tools that promote proper ergonomics and lighting. Rotate staff to the extent possible.	

SECTION 4
Personal Protective Equipment (PPE):
Body Suit - Tyvek or similar if necessary
Level C
Level D
Protective Gloves - Work gloves for moving cores, Kevlar gloves for cutting cores, nitrile gloves for sampling
Safety Glasses
Safety Shoes
Required and/or Recommended Equipment and Supplies: Use hearing protection during core shearing if necessary. Use a body suit and face shield if core processing presents excessive liquid splashing. Monitor breathing zone as dictated in HASP.

JSA002229 - Closed - Current - 01/15/2009 04:01 PM EST

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JOB SAFETY ANALYSIS

SECTION 1	
JSA Type:	Aquatic Investigations
JSA No:	JSA002228
Date:	12/18/2008
Work Type:	Aquatic Inv - Vibracore Sediment Collection
Work Activity:	Vibracore Collection and Transport
Project No.:	B00099870000 - HACKENSACK RIVER (HACKENSACK RIVER)

SECTION 2

Development Team	Position / Title	PC	Reviewed By	Position / Title	Date
Nini, Matthew J.		☑	Hayes, Meredith K.		1/4/2009
			Hebert, Alain P.		1/14/2009
			Larew, Scott M.		1/5/2009

SECTION 3

Job Steps	Potential Hazard (s)	Critical Action(s)	SOP Reference
Working outdoors.	Environmental hazards: sun, heat, cold, flora/fauna, working on and near water, drowning.	Avoid work in extreme weather conditions including small craft advisory. Stop work if extreme weather is clearly approaching. Wear appropriate clothes for weather conditions including a survival suit.	
Launch Boat.	Physical hazards (caught between, struck by). Slips, Trips, Falls. Drowning. Cold water temps (below 50 degrees F).	Use buddy system for directing trailer into launch point. Maintain eye contact with driver and stand to side of vehicle while backing; Keep hands away from pinch points as boat is being launched. Wear soft rubber shoes/boots when walking on boat ramps; Ice crampons or similar may be necessary when temperatures are below 32 degrees; Never stand in the boat while launching. Wear PFD; Boat captain should ask all 'Who can't swim?' Secure boat to dock prior to getting in. Use thermal protective clothing as needed (e.g., wet suits, dry suits, survival suits) if water temperatures are below 50 degrees Fahrenheit.	
Operate boat.	Physical hazards (caught between, struck by). Slips, Trips, Falls. Drowning. Cold water temps (below 50 degrees F). Noise from motor.	Secure items off floor of boat prior to departure; Use three points of contact when entering boat; keep floor of boat dry if possible. Review nautical maps to determine safe boating areas; operate boat at less than full power when underway and when working around construction equipment. Do not overload boat (check manufacturer label for max weight); Wear PFD; Do not stand up or move around in boat while underway. Avoid wakes from larger craft; drive into wakes when unavoidable; Give larger boats and unpowered boats the right of way. Wear hearing protection when operating boat at a speed which makes it difficult to speak normally to passengers.	
Select a	Striking an	Carefully select sample locations to avoid objects. Observe warning signs and pipeline markers when selecting the sample location.	

sample location.	underwater object or pipeline.	Call One Call to locate underground pipelines and utilities. Set GPS to confirm location if necessary.	
Insert core liners into core tube.	Pinch points, repetitive motion, bending/lifting.	Carefully insert core liners into core tube. Core liners will fit snug inside of core tube, use caution to avoid pinching.	
Place rod into the Vibracore unit and clamp shut.	Pinch points, repetitive motion, bending/lifting.	Carefully move rod into place. Clamp shut with caution to avoid pinching.	
Sediment sampling with Vibracore unit	Moving equipment, overhead hazards, pinch points, loud noise, slips/trips/falls	Use caution when lowering Vibracore rod to sediment-water interface. Use caution when working around moving parts on the unit. Carefully unclamp the rod from the unit. Slowly lift the rod and place it on the deck of the sampling boat. Use caution when moving in the area to avoid tripping on core, and slipping on water near cores.	
Transport cores to sample processing area.	Heavy lifting, strains, sprains, pinch points, repetitive motions.	Lift with your legs, avoid bending and awkward postures. Use two people to lift cores. Use work gloves. Survey intended area and paths before initiating lift and movement. Rotate among staff to the extent possible.	
Place boat on trailer.	Physical hazards (caught between, struck by). Slips, Trips, Falls. Drowning. Cold water temps (below 50 degrees F).	Use 3 points of contact when exiting boat; Secure boat to dock prior to getting out; get people off boat before placing boat on trailer; keep hands away from winch while boat is being loaded. Use buddy system for directing trailer into launch point. Maintain eye contact with driver and stand to side of vehicle while backing. Wear PFD until boat and trailer are removed from water.	

SECTION 4
Personal Protective Equipment (PPE):
Hard Hat
Level D
Personal Flotation Device
Protective Gloves - nitrile gloves used for sampling, leather gloves will be used for transporting equipment
Safety Glasses
Safety Shoes
Required and/or Recommended Equipment and Supplies: Survival Suits will be worn by all personnel working on or near the water if conditions warrant; TBD by SSO/PM. Hearing protection and sunscreen required as applicable.

JSA002228 - Closed - Current - 01/15/2009 03:59 PM EST

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JOB SAFETY ANALYSIS

SECTION 1	
JSA Type:	Aquatic Investigations
JSA No:	JSA002233
Date:	12/19/2008
Work Type:	Aquatic Inv - Small Mammal Sampling / Processing
Work Activity:	Aquatic population sampling
Project No.:	B00099870000 - HACKENSACK RIVER (HACKENSACK RIVER)

SECTION 2

Development Team	Position / Title	PC	Reviewed By	Position / Title	Date
Nini, Matthew J.		☑	Hayes, Meredith K.		1/4/2009
			Hebert, Alain P.		1/14/2009
			Larew, Scott M.		1/5/2009

SECTION 3

Job Steps	Potential Hazard (s)	Critical Action(s)	SOP Reference
Working outdoors	Heat/cold stress, uneven walking surfaces, working on/near water, flora and fauna	Take breaks as necessary, stay hydrated, watch for signs of heat/cold stress in other personnel; watch footing, take shorter steps, check local weather forcasts, inspect area for hazardous plants and insects, apply sunscreen and insect repellent as necessary	
Prepare necessary traps, nets and other equipment	Cuts, pinch points, bending, repetitive motion, awkward and/or heavy lifting	Inspect traps to insure that they are in working order and replace or repair any broken traps. Make sure that all traps have been properly decontaminated prior to use as necessary. Wear safety gloves specific to trap or equipment in use. Place necessary equipment (plastic bags, bait, flagging, etc.) in a 5 gallon bucket or similar to facilitate safe and easy transport of equipment from staging area to sample locations.	
Set traps, nets and other equipment	Uneven walking surfaces, working on/near water, flora and fauna, pinch points, cuts, lifting, bending, repetitive motion, awkward and/or heavy lifting	Use the buddy system and have means of contacting others (cell phone, two-way radio, etc.); be aware of changing weather conditions and have a plan for reaching a safe area if severe weather approaches; have appropriate PPE for outside work	
Check traps, nets and other equipment	See previous step. Additional hazards include animal bites and parasites	Don appropriate PPE. Use caution when handling live animals and minimize contact when possible. Put organism in container such as a plastic bag, or bucket for weighing and measuring. Put contaminated traps in sealed plastic bags and store separately from clean traps in clearly labeled containers.	
Process captured	See step 4.	See above. Sort by species, then sort by sex, count total number of each, measure length and weight of all	

animals		animals or a 25-individual subset as appplicable. Place in container and preserve per laboratory specifications.	
Decontaminate and store traps and nets for future use as necessary	See decon JSA. Additional hazards include exposure to contaminated animal matter and/or parasites	See decon JSA	

SECTION 4
Personal Protective Equipment (PPE):
Body Suit - Survival suit is required if weather conditions warrant
Personal Flotation Device
Protective Gloves - Leather gloves, cut/puncture proof, and/or nitrile gloves based on task hazard(s)
Safety Glasses
Safety Shoes
Required and/or Recommended Equipment and Supplies:

JSA002233 - Closed - Current - 01/15/2009 04:03 PM EST

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JOB SAFETY ANALYSIS

SECTION 1	
JSA Type:	Aquatic Investigations
JSA No:	JSA002235
Date:	12/19/2008
Work Type:	Aquatic Inv - Sediment Sampling
Work Activity:	Sediment collection for biota
Project No.:	B00099870000 - HACKENSACK RIVER (HACKENSACK RIVER)

SECTION 2

Development Team	Position / Title	PC	Reviewed By	Position / Title	Date
Nini, Matthew J.		☑	Hayes, Meredith K.		1/4/2009
			Hebert, Alain P.		1/14/2009
			Larew, Scott M.		1/5/2009

SECTION 3

Job Steps	Potential Hazard(s)	Critical Action(s)	SOP Reference
Working outdoors	Heat/cold stress, slips/trips/falls, flora/fauna, working on/near water	Take breaks as necessary, stay hydrated, watch for signs of heat/cold stress in other personnel; watch footing, take shorter steps, check local weather forcasts, inspect area for hazardous plants and insects, apply sunscreen and insect repellent as necessary	
Prepare equipment and work area for sampling	Cuts, pinch points, bending, repetitive motion, awkward and/or heavy lifting	Use proper bending/lifting techniques, inspect all equipment and tools prior to use	
Mobilize to sediment sampling collection locations.	Slips/trips/falls, flora/fauna, working on/near water, cuts, pinch points, bending, repetitive motion, awkward and/or heavy lifting	Use proper bending/lifting techniques, use caution on uneven or potentially soft walking surfaces, use the buddy system	
Collect sediment	Exposure to contaminants, repetitive motion, bending and lifting,	Use proper lifting/bending/pushing/pulling techniques, use proper grip and glove for handling sampler	
Process sediment.	Contaminated sediment/water, pinch points, cross contamination, splashing water/sediment/debris	Use proper lifting and sifting techniques. Package and preserve biota samples per laboratory specifications	

SECTION 4
Personal Protective Equipment (PPE):
Body Suit - Survival suit is required if weather conditions warrant
Protective Gloves - Task specific leather and/or nitrile gloves
Safety Glasses
Safety Shoes
Required and/or Recommended Equipment and Supplies:

JSA002235 - Closed - Current - 01/15/2009 04:05 PM EST

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JOB SAFETY ANALYSIS

SECTION 1	
JSA Type:	Environmental Cleaning and Sampling
JSA No:	JSA002230
Date:	12/18/2008
Work Type:	Environmental - Decontamination of Large Equipment
Work Activity:	Decontamination of Field Equipment
Project No.:	B00099870000 - HACKENSACK RIVER (HACKENSACK RIVER)

SECTION 2

Development Team	Position / Title	PC	Reviewed By	Position / Title	Date
Nini, Matthew J.		☑	Gandhi, Kavin R.		1/15/2009
			Hayes, Meredith K.		1/4/2009
			Hebert, Alain P.		1/14/2009

SECTION 3

Job Steps	Potential Hazard (s)	Critical Action(s)	SOP Reference
Prepare decontamination area	Selection of appropriate decontamination area; site hazards; back strains; slips, trips, and falls	Situate decontamination area in a location designated by the site supervisor or health and safety supervisor; check the decontamination area for uneven surfaces. Utilize appropriate PPE including work boots and leather work gloves.	
Decontamination of small, non-disposable, sampling equipment	Ingestion, inhalation, and absorption of decontamination fluids; slips, trips, and falls; hand, eye, and foot injuries (cuts); lifting hazards; sprains and strains	Perform decontamination activities in an area designed to prevent spillage or leakage of decontamination fluids. Utilize appropriate PPE. Handle equipment carefully using correct bending and lifting techniques. Use proper decontamination techniques, equipment and chemicals per the sampling task, regulatory and client requirements. Establish decontamination boundaries to keep unauthorized personnel away from area.	
Decontamination of large sampling equipment	Ingestion, inhalation, and absorption of decontamination fluids; slips, trips, and falls; hand, eye, and foot injuries (cuts); lifting hazards; sprains and strains	Perform decontamination activities in an area designed to prevent spillage or leakage of decontamination fluids. Utilize appropriate PPE with a splash shield. Handle equipment carefully using correct bending and lifting techniques. Use proper decontamination techniques, equipment and chemicals per the sampling task, regulatory and client requirements. Use caution while working with high pressure washing equipment including avoiding the hot surfaces of steam cleaners and water jet blast of sprayers. Use caution if walking on wet plastic sheeting. Establish decontamination boundaries to keep unauthorized personnel away from area.	

Collection of decontamination fluids	Spillage of decontamination fluids	Utilize nitrile gloves. Handle equipment and containers carefully.	

SECTION 4
Personal Protective Equipment (PPE):
Body Suit - Tyvek or equivalent if necessary for large equipment
Level D
Protective Gloves - nitrile or latex
Safety Glasses
Safety Shoes
Required and/or Recommended Equipment and Supplies: DI water, Water/alconox mixture, methanol, 10% nitric acid, hexane

JSA002230 - Closed - Current - 01/15/2009 04:38 PM EST

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Attachment D

PPE Equipment List

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PPE CHECKLIST

R = Equipment required to be present on the site. **O** = Optional equipment. Subcontractors must have the same equipment listed here as a minimum.

Description (Put Specific Material or Type in Box)	Level Of Protection		
	D	C	B
Body			
Coveralls			
Chemical Protective Suit	O		
Splash Apron	R		
Rain Suit	R		
Traffic Safety Vest (reflective)	R		
Head			
Hard Hat (if does not create other hazard)	R		
Head Warmer (depends on temperature and weather conditions)	O		
Eyes & Face			
Safety Glasses (incorporate sun protection as necessary)	R		
Goggles (based on hazard)	O		
Splash Guard (based on hazard)	O		
Ears			
Ear Plugs	R		
Ear Muffs	O		
Hands and Arms			
Outer Chemical Resistant Gloves	R		
Inner Chemical Resistant Gloves	R		
Insulated Gloves	R		
Work Gloves*	R		
Foot			
Safety Boots (steel toe and shank)	R		
Rubber, Chemical Resistant Boots	O		
Rubber Boots	O		
Disposable Boot Covers	O		
Respiratory Protection			
1/2 Mask APR			
Full Face APR			
Dust Protection			
Powered APR			
SCBA			
Air Line			

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Attachment E

Forms and MSDSs

ARCADIS

SITE ACTIVITIES TAILGATE HEALTH & SAFETY BRIEFING FORM

This briefing form documents the tailgate briefing conducted in accordance with the HASP. Personnel who perform work operations on site are required to attend each briefing and to acknowledge receipt of each briefing, at least daily.

Project Number:		**Project Name:**
Date:	**Time:**	**Briefing Conducted by:**
Company:		**Signature/Title:**

TRACKing the Tailgate Briefing

Think through the Tasks (list the tasks for the day):

1 _____ 3 _____ 5 _____

2 _____ 4 _____ 6 _____

Recognize the hazards (check all those that are discussed) and **Assess** the Risks (Low, Medium, High-circle risk level)

☐ Confined Space (L M H)	☐ Buried/Overhead Utilities (L M H)	☐ Excavation (L M H)
☐ Walking/Working surfaces (L M H)	☐ Chemical Exposure (L M H)	☐ Noise (L M H)
☐ Thermal Stress (Hot/Cold) (L M H)	☐ Overhead Hazards (L M H)	☐ Traffic/Roadway/Railway (L M H)
☐ Severe Weather (L M H)	☐ Chemical Usage (L M H)	☐ Elevated work (L M H)
☐ Hazardous Energy (L M H)	☐ Heavy Machinery (L M H)	☐ Biological/Animals (L M H)
☐ Ergonomic (L M H)	☐ Personal Safety/Security (L M H)	☐ Mining (L M H)
☐ Client/Other Site Activities ***List***	☐ Chemical Exposure ***List***	☐ Other ***Specify***
_____ (L M H)	_____ (L M H)	_____ (L M H)
_____ (L M H)	_____ (L M H)	_____ (L M H)
_____ (L M H)	_____ (L M H)	_____ (L M H)

Control the hazards (Check all those methods to control the hazards that apply):

☒ **STOP WORK AUTHORITY** (Must be addressed in every Tailgate meeting-*See H&S Handbook for definition*)

☐ General PPE Usage	☐ Hearing Conservation	☐ Respiratory Protection
☐ Personal Hygiene	☐ Exposure Guidelines	☐ Decon Procedures
☐ Emergency Action Plan	☐ Fall Protection	☐ Work Zones/Site Control
☐ JSA to be developed/used ***(specify)***	☐ LPO conducted ***(specify job/JSA)***	☐ Other ***(specify)***
_____	_____	_____
_____	_____	_____
_____	_____	_____

Personnel Sign-in List

Printed Name	Signature

Keep H&S 1st in all things

Use the back to add comments such as recent near misses, injuries or property damage, visitors to the site, etc

SITE ACTIVITIES TAILGATE HEALTH & SAFETY BRIEFING FORM

Additional Comments:

Discussion of recent results of LPOs conducted on the project:

Discussion of recent Near-miss, injuries, and/or property damage on the project:

List Visitors to Site Today:

Real Time Exposure Monitoring Data Collection Form

Document all air monitoring conducted on the Site below. Keep this form with the project file.

Site Name: _____ Date: _____

Instrument: _____ Model: _____ Serial #: _____

Calibration Method: (Material used settings, etc.)	
Calibration Results:	
Calibrated By:	

Activity Being Monitored	Compounds/Hazards Monitored	Time	Reading	Action Required? Y/N

Describe Any Actions Taken as a Result of this Air Monitoring and Why (does it match Table 5-1):

_____

_____

Employee Signature Form

I certify that I have read, understand, and will abide by the safety requirements outlined in this HASP.

Printed Name	Signature	Date

Subcontractor Acknowledgement: Receipt of HASP Signature Form

ARCADIS claims no responsibility for the use of this HASP by others although subcontractors working at the site may use this HASP as a guidance document. In any event, ARCADIS does not guarantee the health and/or safety of any person entering this site. Strict adherence to the health and safety guidelines provided herein will reduce, but not eliminate, the potential for injury at this site. To this end, health and safety becomes the inherent responsibility of personnel working at the site.

Printed Name	Company	Signature	Date

Visitor Acknowledgement and Acceptance of HASP Signature Form

By signing below, I waive, release and discharge the owner of the site and ARCADIS and their employees from any future claims for bodily and personal injuries which may result from my presence at, entering, or leaving the site and in any way arising from or related to any and all known and unknown conditions on the site.

Name	Company	Reason for Visit	Date/Time On Site	Date/Time Off Site

Hazardous Materials Transportation Form

	Vehicle (place X in box)	Type (pick-up, car, box truck, etc.)
Personal		
Rental		
ARCADIS owned/leased		
Government owned		
Trailer		

Materials Transported	Quantity	Storage/Transport Container

List Trained Drivers:

_____

_____

Hazardous Materials Shipment Form

Material Description and Proper Shipping Name (per DOT or IATA)	Shipment Quantity	DOT Hazard Classification	Shipment Method (air/ground)

List Shipper (i.e., who we are offering the shipment to):

_____

_____

List Trained Employee(s):

_____

_____

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: 1,2-Dichlorobenzene **CAS Number:** 95-50-1
Chemical Formula: $C_6H_4Cl_2$
Structural Chemical Formula: $C_6H_4Cl_2$
EINECS Number: 202-425-9
ACX Number: X1001576-4
Synonyms: BENZENE,1,2-DICHLORO-; BENZENE,O-DICHLORO-; CHLOROBEN; CHLORODEN; CLOROBEN; DCB; O-DCB; O-DICHLOR BENZOL; O-DICHLORBENZENE; 1,2-DICHLOROBENZENE; O-DICHLOROBENZENE; ORTHO-DICHLOROBENZENE; DICHLOROBENZENE,ORTHO,LIQUID; O-DICHLOROBENZOL; DILANTIN DB; DILATIN DB; DIZENE; DOWTHERM E; EPA PESTICIDE CHEMICAL CODE 059401; ODB; ODCB; ORTHODICHLOROBENZENE; ORTHODICHLOROBENZOL; ORTHOSOL; SPECIAL TERMITE FLUID; TERMITKIL
General Use: Solvent for oils, resins, waxes, gums, tars, rubbers, asphalts, oxides of nonferrous metals. Has been used as heat transfer media. Component of dyes, metal polishes, degreasers for leather, metals and wool. Used as an insecticide and fumigant; industrial odor control. Solvent carrier in production of toluene diisocyanate.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,2-dichlorobenzene	95-50-1	>95
1,4-dichlorobenzene	106-46-7	4-5

OSHA PEL
Ceiling: 50 ppm, 300 mg/m^3.

NIOSH REL
Ceiling: 50 ppm (300 mg/m^3).

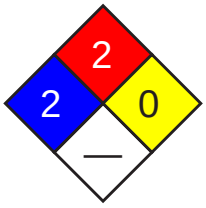
DFG (Germany) MAK
TWA: 10 ppm; PEAK: 20 ppm; skin.

ACGIH TLV
TWA: 25 ppm; STEL: 50 ppm.

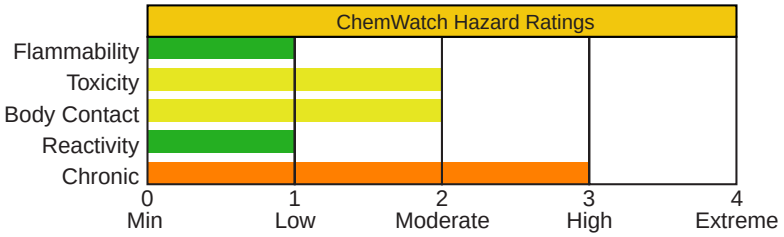
IDLH Level
200 ppm.

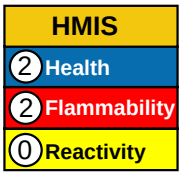
EU OEL
TWA: 20 ppm; STEL: 50 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; aromatic odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: blisters, burning pain in stomach, nausea, vomiting, diarrhea. Chronic Effects: headache, anorexia, weight loss, jaundice, cirrhosis. Combustible.

Potential Health Effects

Target Organs: liver, kidneys, skin, eyes
Primary Entry Routes: inhalation, skin absorption
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
The vapor from heated material is highly discomforting and harmful if inhaled.
Inhalation of vapor may result in nausea, headache. Intermittent exposure at 100 ppm in the workplace caused some irritation to both eyes and upper respiratory system.

Rats survived inhalation exposure for 2 hours at 977 ppm but died after 7 hour exposure. Rats surviving a 7 hour exposure at 539 ppm showed liver necrosis and kidney tubule damage. Liver damage was evident in other rats exposed from 50 to 800 ppm and during exposures lasting 0.5 and 1 hour at 390 ppm. Mouse exposed to the saturated vapor (calculated as between 2000 and 3000 ppm) showed prompt narcosis, followed by central respiratory depression and cyanosis - death occurred within 24 hours. 8000 ppm produced sedation in dogs exposed for 1 hour. Rats exposed at a concentration of 450 ppm, 6 hours/day for up to 13 days showed pale, discolored kidneys.

Eye: The liquid is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The vapor is discomforting to the eyes.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Undiluted o-DCB applied to rabbit eye caused pain and slight conjunctival irritation. Irritation cleared within 5 days without residual injury.

Skin: The liquid is highly discomforting to the skin and it is absorbed by the skin and is capable of causing skin reactions which may lead to dermatitis or ulceration if exposure is prolonged.
Toxic effects may result from skin absorption.
The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic).
This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis.
Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.
o-DCB was irritating when applied to the skin of human subjects for 15-60 minutes. One worker developed a dermatitis following hand contact that was reported as sensitization after a follow-up patch test. Two subjects reported a burning sensation during a 1 hour exposure. A diffuse redness of the treated area progressed to a darker red color with blister formation within 24 hours. A brown pigment formed at the site which was apparent 3 months postexposure.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is highly discomforting and toxic if swallowed.
Ingestion may result in nausea, abdominal irritation, pain and vomiting.
Oral doses of 500 mg given over 13 weeks to mice and rats produced necrosis and hepatocellular degeneration and depletion of lymphocytes in both the spleen and thymus and renal tubular degeneration in rats.
Multifocal mineralization of the myocardial fibers of the heart and skeletal muscle was seen in mice. Necrosis of individual hepatocytes was seen in female mice given 250 mg/kg. At 125 mg/kg a few rats exhibited minimal hepatocellular necrosis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic inhalation exposure may cause changes to liver and kidney and hematological (blood) disorders.
There is some evidence to suggest a link between leukemia and exposure to dichlorobenzenes.
A 2 year study with rats and mice treated with oral doses of either 60 or 120 mg 5 days/ week produced a lower survival time of male rats receiving the higher dose. An increase in the incidence of tubular regeneration in the male mouse kidney was the only compound-related, non-neoplastic, histologic lesion observed and no evidence of carcinogenicity was seen during the study.
Four cases involving cancer and exposure to o-DCB have been reported.
These involved the development of peripheral leukoblastosis, chronic lymphoid leukemia and myeloblastic leukemia.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: If in eyes, hold eyes open, flood with water for at least 15 minutes and see a doctor.

Skin Contact: If skin contact occurs, remove contaminated clothing and wash skin thoroughly.

Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
Avoid giving alcohol.

After first aid, get appropriate in-plant, paramedic, or community medical support.

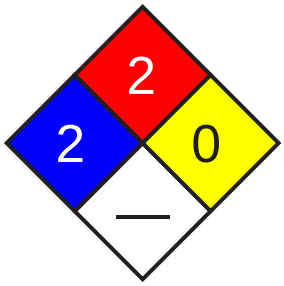
Note to Physicians: Treat symptomatically. Do not give adrenalin (epinephrine) or related drugs.

o-DCB is absorbed through the lungs, gastrointestinal tract and intact skin. High lipid solubility and low water solubility causes diffusion through most membranes. Metabolites include 3,4-dichlorophenol, 2,3-dichlorophenol and 3,4- and 4,5-dichlorocatechols. The conjugates excreted in the urine are mainly glucuronides.

Section 5 - Fire-Fighting Measures

Flash Point: 68.333 °C Open Cup
Autoignition Temperature: 648 °C
LEL: 2% v/v
UEL: 9% v/v
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Combustible liquid. Moderate fire hazard when exposed to heat or flame.
May form an explosive mixture with air.
Decomposes on heating and produces toxic fumes of hydrogen chloride, carbon monoxide (CO), carbon dioxide (CO_2) and minor amounts of chlorine.

See DOT ERG



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Avoid contact with hot aluminum and aluminum alloys.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
If safe to do so, switch off electrical equipment until vapor fire hazard is removed.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: POLLUTANT -contain spillage. Environmental hazard - contain spillage.
Clean up all spills immediately.
Wear protective clothing, impervious gloves and safety glasses.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Place spilled material in clean, dry, sealable, labeled container.

See DOT ERG

Large Spills: POLLUTANT -contain spillage. Environmental hazard - contain spillage.
Contact fire department and tell them location and nature of hazard.
Clear area of personnel and move upwind.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
Shut off all possible sources of ignition and increase ventilation.
No smoking or bare lights within area.
Stop leak if safe to do so.
Absorb or cover spill with sand, earth, inert material or vermiculite.
Recover liquid and place in labeled, sealable container for recycling.
Collect residues and seal in labeled drums for disposal.
Wash spill area with detergent and water.
If contamination of drains or waterways occurs, advise emergency services.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Prevent concentration in hollows and sumps. DO NOT enter confined spaces until atmosphere has been checked.
Avoid contact with incompatible materials.
Avoid smoking, bare lights or ignition sources.
Avoid physical damage to containers.
Keep containers securely sealed when not in use.
Use in a well-ventilated area.
Wear personal protective equipment when handling.
When handling, DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling. Work clothes should be laundered separately.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
If mist is present, use air supplied breathing apparatus.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream and Neoprene rubber gloves or PVA gloves.
Safety footwear or Rubber boots.
Respiratory Protection:
Exposure Range >50 to <200 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 200 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)
Other: Impervious protective clothing or Rubber apron.
Eyewash unit.
Ensure there is ready access to a safety shower.
Glove Selection Index:
VITON ..... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless to pale yellow liquid, pleasant aromatic odor. Soluble in alcohol, aromatics, acetone.
Physical State: Liquid
Odor Threshold: 12 to 300 mg/m^3
Vapor Pressure (kPa): 0.133 at 20 °C
Vapor Density (Air=1): 5.07
Formula Weight: 147.00
Specific Gravity (H_2O=1, at 4 °C): 1.305 at 20 °C
Evaporation Rate: < 1
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 180.5 °C (357 °F) at 760 mm Hg
Freezing/Melting Point: -17 °C (1.4 °F)
Volatile Component (% Vol): 100 approx.
Water Solubility: 0.01% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers DO NOT use aluminum, galvanized or tin-plated containers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 500 mg/kg
Intraperitoneal (rat) LD_{50}: 840 mg/kg
Subcutaneous (rat) LD_{50}: 5000 mg/kg
Inhalation (rat) LD_{Lo}: 821 ppm/7 hr
Oral (mouse) LD_{50}: 4386 mg/kg
Intraperitoneal (mouse) LD_{50}: 1228 mg/kg
Oral (rabbit) LD_{50}: 500 mg/kg
Diffuse and zonal hepatocellular necrosis, lachrymation, general anesthesia, paternal effects, specific developmental anormalities (musculoskeletal system) recorded.

Irritation
Eye (rabbit): 100 mg/30 s rinse-mild

See *RTECS* CZ 4500000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it can be moderately to tightly adsorbed. Leaching from hazardous waste disposal areas has occurred and the detection in various groundwaters indicates that leaching can occur. Volatilization from soil surfaces may be an important transport mechanism. It is possible it will be slowly biodegraded in soil under aerobic conditions. Chemical transformation by hydrolysis, oxidation or direct photolysis are not expected to occur in soil. If released to water, adsorption to sediment will be a major environmental fate process based upon extensive monitoring data in the Great Lakes area and K_{oc} values. Analysis of Lake Ontario sediment cores has indicated the presence and persistence since before 1940. It is volatile from the water column with an estimated half-life of 4.4 hours from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec at 20 °C; adsorption to sediment will attenuate volatilization. Aerobic biodegradation in water may be possible, however, anaerobic biodegradation is not expected to occur. Experimental BCF values of 66-560 have been reported it has been detected in trout from Lake Ontario. Aquatic hydrolysis, oxidation and direct photolysis are not expected to be important. If released to air, it will exist predominantly in the vapor-phase and will react with photochemically produced hydroxyl radicals at an estimated half-life rate of 24 days in a typical atmosphere. Direct photolysis in the troposphere is not expected to be important. The in rainwater suggests that atmospheric removal via wash-out is possible.
Ecotoxicity: Aquatic toxicity: 13 ppm/*/marine plankton/no growth/ salt water *Time period not specified
Henry's Law Constant: 0.0024
BCF: rainbow trout 270 to 560
Biochemical Oxygen Demand (BOD): theoretical < 0.1 lb/lb, 1/8 days
Octanol/Water Partition Coefficient: log K_{ow} = 3.38
Soil Sorption Partition Coefficient: K_{oc} = 280

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: o-Dichlorobenzene
ID: UN1591
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols: + - Override definitions
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, T4, TP1
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U070 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

1,2,4-Trichlorobenzene
TRI2350

Section 1 - Chemical Product and Company Identification 61

Material Name: 1,2,4-Trichlorobenzene **CAS Number:** 120-82-1
Chemical Formula: $C_6H_3Cl_3$
Structural Chemical Formula: $C_6H_3Cl_3$
EINECS Number: 204-428-0
ACX Number: X1001590-4
Synonyms: BENZENE,1,2,4-TRICHLORO-; HOSTETEX L-PEC; 1,2,4-TRICHLOROBENZENE; 1,2,5-TRICHLOROBENZENE; 1,3,4-TRICHLOROBENZENE; 1,2,4-TRICHLOROBENZOL; TROJCHLOROBENZEN; UNSYM-TRICHLOROBENZENE
General Use: Solvent in chemical manufacture, dyes and intermediates, dielectric fluid, synthetic transformer oils, lubricants, heat-transfer medium, insecticides.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,2,4-trichlorobenzene	120-82-1	>98

OSHA PEL

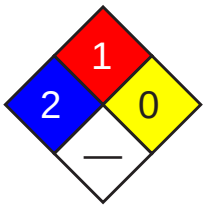
NIOSH REL
Ceiling: 5 ppm (40 mg/m^3).

DFG (Germany) MAK
Skin.

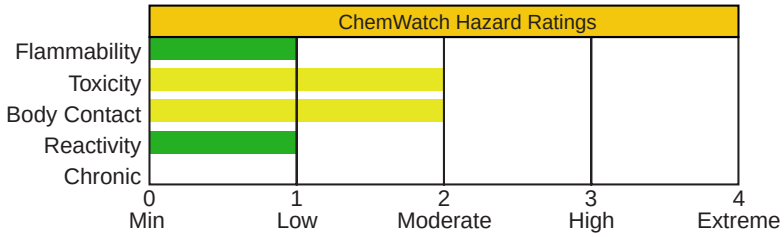
ACGIH TLV
Ceiling: 5 ppm.

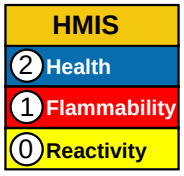
EU OEL
TWA: 2 ppm; STEL: 5 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Caution

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, liquid; aromatic odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: uncoordination, narcosis, tremors, headache, restlessness, increased heart rate/blood pressure. Chronic Effects: liver/kidney/lung damage (animal data).

Potential Health Effects

Target Organs: skin, eyes, mucous membranes
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
Inhalation of vapor may aggravate a pre-existing respiratory condition.
Target organs from non-lethal exposures of cats, dogs, rats, rabbits and guinea pig include liver, kidney and ganglion cells of the brain. Local pulmonary irritation of the lungs and dyspnea were recorded in animals which later died after inhaling 1,2,4-TCB. Sublethal doses cause liver damage in guinea pigs and lethargy and weight gain in other animals.

Eye: The liquid is discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is highly discomforting to the eyes.
Skin: The liquid may produce skin discomfort following prolonged contact.
Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed. Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.
Chronic Effects: No human exposure data available. For this reason health effects described are based on experience with chemically-related materials.

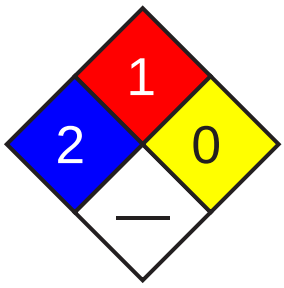
Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.
Ingestion: Contact a Poison Control Center. Do NOT induce vomiting. Give a glass of water.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Treat symptomatically.

Section 5 - Fire-Fighting Measures

Flash Point: 105 °C Closed Cup
Autoignition Temperature: 571 °C
LEL: 2.5% v/v
UEL: 6.6% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Combustible. Slight fire hazard when exposed to heat or flame.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit acrid smoke.
Mists containing combustible materials may be explosive.
Combustion products include hydrogen chloride.
Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Use water delivered as a fine spray to control fire and cool adjacent area.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with sand, earth, inert material or vermiculite.
Wipe up. Place in a suitable labeled container for waste disposal.

See DOT ERG

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Neutralize/decontaminate residue.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses; safety glasses with side shields; chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.

Respiratory Protection:
Exposure Range >5 to 50 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >50 to 500 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >500 to 5000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >5000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Impervious protective clothing.
Eyewash unit.

Glove Selection Index:
NITRILE ..... Best selection
TEFLON ..... Best selection
VITON/NITRILE..... Best selection
PE..... Poor to dangerous choice for other than short-term immersion

SARANEX-23 ..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless liquid with odor resembling that of o-dichlorobenzene. Miscible with ether, benzene, petroleum ether, carbon disulfide. Volatile with steam.

Physical State: Liquid
Odor Threshold: 24.0 mg/m^3
Vapor Pressure (kPa): 0.1 at 40 °C
Vapor Density (Air=1): >6
Formula Weight: 181.44
Specific Gravity (H_2O=1, at 4 °C): 1.46
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 213.5 °C (416 °F) at 760 mm Hg
Freezing/Melting Point: 17 °C (62.6 °F)
Water Solubility: 19 ppm at 22 °C in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity

Oral (rat) TD_{Lo}: 1800 mg/kg
Oral (rat) LD_{50}: 756 mg/kg
Intraperitoneal (mouse) LD_{50}: 1223 mg/kg
Bacterial mutagen, altered sleep times, somnolence, convulsions, ataxia, maternal effects, effects on embryo, fetotoxicity, fetolethality recorded.

Irritation

Skin (rabbit): 1950 mg/13w - I
- moderate

See *RTECS* DC 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If it is released to the soil it will probably adsorb to the soil and therefore will not leach appreciably through soil. However, it has been detected in some groundwater samples. It will not hydrolyze or biodegrade in groundwater, but it may biodegrade slowly in the soil based upon the data from one experiment. If released to water it will adsorb to the sediments and may bioconcentrate in aquatic organisms. It will not hydrolyze in surface waters but it may be subject to slow biodegradation. It is expected to evaporate from water with half-lives of 11-22 days for evaporation from a study of a physically mixed, 5.4 m deep seawater microcosm and a half-life of 4.2 hr predicted for evaporation from a model river 1 m deep, flowing at 1 m/sec with a wind velocity of 3 m/sec. Adsorption to sediments or absorption by microorganisms may minimize the rate of evaporation. A half-life of 450 years has been reported for sunlight photolysis in surface waters at 40 deg latitude in summer. If released to the atmosphere, it may react with photochemically produced hydroxyl radicals with a resulting estimated vapor phase half-life in the atmosphere of 18.5 days.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) > 46.8 mg/l/24 hr; > 46.8 mg/l/48 hr; 21.4 mg/l/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 2.4 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo gairdneri (rainbow trout) 1.95 mg/l/48 hr at 15 °C /Conditions of bioassay not specified

Henry's Law Constant: calculated at 3.9 x10^{-3}

BCF: rainbow trout 980 to 1620

Biochemical Oxygen Demand (BOD): theoretical 78%, 20 days

Octanol/Water Partition Coefficient: log K_{ow} = 4.02

Soil Sorption Partition Coefficient: K_{oc} = 1441

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Trichlorobenzenes, liquid
ID: UN2321
Hazard Class: 6.1 - Poisonous materials
Packing Group: III - Minor Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB3, T4, TP1
Packaging: **Exceptions:** 153 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: 1,4-Dichlorobenzene
CAS Number: 106-46-7
Chemical Formula: $C_6H_4Cl_2$
Structural Chemical Formula: $C_6H_4Cl_2$
EINECS Number: 203-400-5
ACX Number: X1001577-1
Synonyms: 1,4-Dichlorobenzene; 1,4-DICHLOROBENZENE; BENZENE,1,4-DICHLORO-; BENZENE,P-DICHLORO-; P-CHLOROPHENYL CHLORIDE; PARA CRYSTALS; P-DCB; 1,4-DICHLOORBENZEEN; P-DICHLOORBENZEEN; 1,4-DICHLOR-BENZOL; P-DICHLORBENZOL; DI-CHLORICIDE; P-DICHLOROBENZENE; PARA-DICHLOROBENZENE; DICHLOROBENZENE,PARA,SOLID; P-DICHLOROBENZOL; PARA-DICHLOROBENZOL; DICHLOROCIDE; 1,4-DICLOROBENZENE; P-DICLOROBENZENE; EPA PESTICIDE CHEMICAL CODE 061501; EVOLA; GLOBOL; PARACIDE; PARADI; PARADICHLORBENZOL; PARADICHLOROBENZENE; PARADICHLOROBENZOL; PARADOW; PARAMOTH; PARANUGGETS; PARAZENE; PDB; PDCB; PERSIA-PERAZOL; SANTOCHLOR
General Use: As an insecticidal fumigant, moth repellant for fabric and fur, germicide. Deodorant toilet blocks, urinal disinfectant. As a space odorant. In dyes, intermediates, pharmacy, agriculture (fumigating soil); In the manufacture of 2,5-dichloroaniline.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
1,4-dichlorobenzene	106-46-7	>97

OSHA PEL
TWA: 75 ppm; 450 mg/m^3.

NIOSH REL

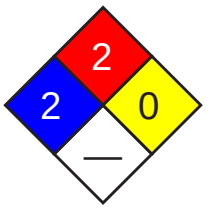
DFG (Germany) MAK
Skin.

ACGIH TLV
TWA: 10 ppm.

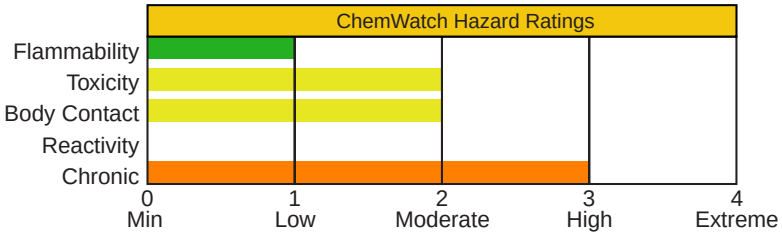
IDLH Level
150 ppm.

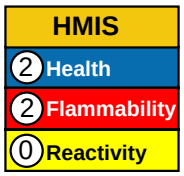
EU OEL
TWA: 20 ppm; STEL: 50 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Volatile, white crystals; mothball-like odor. Severely irritating. Other Acute Effects: hemolytic anemia, jaundice, methemglobinemia. Chronic Effects: lung granulomatosis, liver abnormalities, kidney damage, anemia, cataracts. Possible cancer hazard. Combustible.

Potential Health Effects

Target Organs: liver, respiratory system, eyes, kidneys, skin
Primary Entry Routes: inhalation, skin contact

Acute Effects

Inhalation: The vapor is discomforting to the upper respiratory tract if inhaled and the material may present a hazard from repeated exposures over long periods. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

The physiological response to p-DCB is primarily injury to the liver and secondarily to the kidneys. Central nervous system depression will occur at concentrations that are extremely objectionable to the eyes and nose.

Individuals exposed to higher concentrations may show weakness, dizziness and weight loss. Vomiting may occur. Acute hemolytic anemia with methemoglobinemia has been reported.

Prolonged inhalation exposure may cause dizziness, headache nausea, vomiting, central nervous system depression and damage to liver and kidneys.

Rabbits exposed 8 hours/day for a total of 62 exposures in 83 days at 770-800 ppm exhibited tremors, weakness, and death along with edema of the cornea and opacity of the lens.

Eye: The material is highly discomforting to the eyes and is capable of causing pain and severe conjunctivitis. Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.

The vapor is discomforting to the eyes if exposure is prolonged.

The vapor from heated material is highly discomforting to the eyes.

Vapors from heated material may cause mild corneal damage.

Solid particles in the eye are reported to be very painful. At workplace concentrations ranging from 50-170 ppm periodic medical examination found no evidence of adverse effects in workers with particular reference to ocular lesions including cataracts. Painful irritation of eyes and nose has been recorded at 80-160 ppm.

Skin: The material is moderately discomforting to the skin and it is absorbed by skin.

Toxic effects may result from skin absorption. Absorption by skin may readily exceed vapor inhalation exposure. Symptoms for skin absorption are the same as for inhalation. Bare unprotected skin should not be exposed to this material. The material may accentuate any pre-existing skin condition.

Skin contact may result in irritation, burning sensation, skin defatting and possible dermatitis. Skin contact resulted in dermatitis when workers handled cakes of the pure chemical. Prolonged occlusive contact will produce a burning sensation.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The material is discomforting and toxic if swallowed.

Large doses have caused tremor in exposed animals; insects exhibit symptoms resembling DDT poisoning.

Hepatic porphyria was produced in rats following seven consecutive doses of 770 mg p-DCB/kg. Slight to moderate corneal opacity was noted in rabbits following 3 weeks of daily dosing with 5000 mg/kg. Rats receiving a daily dose of 500 mg/kg for 20 days showed cloudy swelling and necrosis in the central areas of the liver lobules and swelling of the renal tubular epithelium. 100 mg/kg daily doses did not reproduce this finding. Pale and mottled kidneys were seen in rats given oral doses of 70 to 428 mg/kg/day for 28 days. Rats given 1200 mg/kg for 13 weeks showed degeneration and necrosis of hepatocytes, hypoplasia of the bone marrow, lymphoid depletion of the spleen and thymus, and epithelial necrosis of the nasal turbinates and small intestinal mucosa. At doses of 300 mg/kg male rats showed kidney damage characterized by degeneration or necrosis of the renal cortical tubular epithelial cells. Female rats did not show these lesions even at doses of 1500 mg/kg.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2B, Possibly carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A3, Animal carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: In individuals exposed chronically to p-DCB, liver effects including jaundice, cirrhosis, and possible death may occur. Chronic exposure may also produce weakness, headache, rhinitis, twitching of the facial muscles. A woman who consumed 4 to 5 moth ball pellets daily for 2.5 years developed unsteady gait, tremors of the hand and general mental sluggishness which disappeared 4 months after exposure ceased. Eight workers manufacturing p-DCB based mothproofing agents for 1 to 7 months developed neural disorders including intensified muscle reflexes, mild clonus of the ankle and tremors of the fingers. They reported loss of appetite and hemopoietic changes.

Rats treated for 2 years with gastric intubation showed kidney lesion and in the male, hyperplasia of the thyroid at dose rates of 150 mg/kg.

Mice treated with 300 mg/kg in a similar 2 year gavage study showed liver changes characterized by hepatocellular degeneration. Thyroid follicular cell hyperplasia was increased in male but not female mice. Nephropathy consisting primarily of degeneration of the cortical tubular epithelium was seen and was more pronounced in males.

Rats, guinea pigs, rabbits, mice and monkeys exposed by inhalation 7 hours/day, 5 days/week for 140 exposures at 800 ppm exhibited tremor, weight loss and liver changes, including swelling and central necrosis in female rats, and swelling of the kidney epithelium.

An increase in liver tumors (e.g. renal tubular cell adenocarcinomas) was seen in male rats treated by gastric intubation doses of 150 mg/kg for 2 years. No evidence of carcinogenicity was seen in female rats. An increase incidence of hepatocellular carcinomas and adenomas was seen in mice treated with gavage doses of 300 mg/kg/day for 2 years. A positive dose-trend for adrenal gland pheochromocytomas in male mice was also reported.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush with fresh running water.
Ensure irrigation under the eyelids by occasionally lifting upper and lower lids. If pain persists or recurs seek medical attention.
Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
If more than 15 minutes from a hospital, induce vomiting, preferably using Ipecac Syrup APF.
Note: DO NOT INDUCE VOMITING in an unconscious person.
Avoid giving milk or oils.

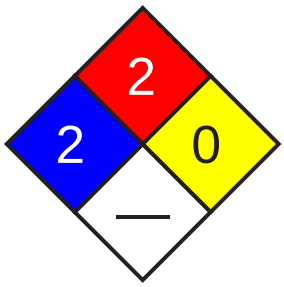
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically.
EYES - Stain for evidence of corneal injury.
SKIN - Treat as for dermatitis.
RESPIRATION - Administer oxygen if available. The use of bronchodilators, expectorants and antitussives may help.
There is no antidote for systemic effects.
Readily absorbed after oral administration to rats and found in all organs with accumulation in adipose tissues. 90% of the dose is excreted within 48 hours. Two metabolites, 2,5-dichlorophenylmethylsulfone and 2,5-dichlorophenylsulfoxide are detected in the blood (though not the compound itself). Slow release from the adipose tissues is probably responsible for the persistence of these metabolites. 2,5-dichlorophenol is detected in plasma, urine, liver, kidneys and fatty tissues - in humans this metabolite is a useful monitor of exposure. An occupational exposure for 1 week to 7.4 ppm p-DCB produced an increase of p-DCB in the urine as a direct measurement.

Section 5 - Fire-Fighting Measures

Flash Point: 65.556 °C Closed Cup
Autoignition Temperature: > 482 °C
LEL: 2.5% v/v
UEL: 16% v/v

See DOT ERG



Fire Diamond

Extinguishing Media: Water spray or fog; foam.
Dry chemical powder.
Alcohol stable foam.
Carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Combustible. Slight fire hazard when exposed to heat or flame.
Heat may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit acrid smoke. May emit poisonous fumes.
Decomposes on heating and produces toxic fumes of hydrogen chloride, chlorine, carbon monoxide (CO), phosgene and carbon dioxide (CO_2).

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result. Avoid contact with aluminum, powdered metals.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid contact with skin and eyes.
Control personal contact by using protective equipment.
Use dry clean-up procedures and avoid generating dust.

See DOT ERG

Place in a suitable labeled container for waste disposal.
Large Spills: Clear area of personnel and move upwind. Slippery when spilled.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Collect solid residues and seal in labeled drums for disposal.
Wash area with detergent and water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
DO NOT allow material to contact humans, exposed food or food utensils.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Recommended Storage Methods: Glass container; Metal can. Steel drum.
DO NOT use aluminum or galvanized containers.
Check that containers are clearly labeled.
Packaging as recommended by manufacturer.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.
Respiratory Protection:
Exposure Range >75 to <150 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 150 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black with dust/mist prefilter (use P100 or consult supervisor for appropriate dust/mist prefilter)
Other: Overalls. Eyewash unit.
Glove Selection Index:
NEOPRENE..... Satisfactory; may degrade after 4 hours continuous immersion
NITRILE..... Poor to dangerous choice for other than short-term immersion
PVC..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Volatile, white crystals with penetrating, aromatic odor. Sublimes (evaporates) at room temperature. Soluble in alcohol, acetone aromatics.
Physical State: Divided solid
Odor Threshold: 15 to 30 ppm
Vapor Pressure (kPa): 1.33 at 54.8 °C
Vapor Density (Air=1): 5.08
Formula Weight: 147.0
Specific Gravity (H_2O=1, at 4 °C): 1.46
Evaporation Rate: Slow
pH (1% Solution): Not applicable.

Boiling Point: 174 °C (345 °F) at 760 mm Hg
Freezing/Melting Point: 53.1 °C (127.58 °F)
Volatile Component (% Vol): 100
Decomposition Temperature (°C): >55
Water Solubility: 65.3 mg/L at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers. DO NOT use aluminum or galvanized containers.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 2000-3000 mg/kg
Oral (human) LD_{Lo}: 857 mg/kg
Oral (human) TD_{Lo}: 300 mg/kg
Oral (rat) LD_{50}: 500 mg/kg
Dermal (rabbit) LD_{50}: >2000 mg/kg
Intraperitoneal (rat) LD_{50}: 2562 mg/kg
Oral (mouse) LD_{50}: 2950 mg/kg
Intraperitoneal (mouse) LD_{50}: 2000 mg/kg
Oral (rabbit) LD_{50}: 2830 mg/kg
Dermal (rabbit) LD_{50}: >2000 mg/kg
Eye effects, respiratory tract changes, diarrhea, specific developmental effects (cardiovascular system) recorded.

Irritation

Eye (human): 80 ppm

See *RTECS* HT 7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it can be moderately to tightly adsorbed. Leaching from hazardous waste disposal areas has occurred and the detection in various groundwaters indicates that leaching can occur. Volatilization from soil surfaces may be an important transport mechanism. It is possible it will be slowly biodegraded in soil under aerobic conditions. Chemical transformation by hydrolysis, oxidation or direct photolysis are not expected to occur in soil. If released to water, volatilization may be the dominant removal process. The volatilization half-life from a model river one meter deep flowing one meter/sec with a wind velocity of 3 m/sec is estimated to be 4.3 hours at 20 °C. Adsorption to sediment will be a major environmental fate process based upon extensive monitoring data in the Great Lakes area and K_{oc} values based upon monitoring samples. Analysis of Lake Ontario sediment cores has indicated presence and persistence since before 1940. Adsorption to sediment will attenuate volatilization. Aerobic biodegradation in water may be possible, however, anaerobic biodegradation is not expected to occur. For the most part, experimental BCF values reported in the literature are less than 1000 which suggests that significant bioconcentration will not occur; however, a BCF of 1800 was determined for guppies in one study. Aquatic hydrolysis, oxidation and direct photolysis are not expected to be important. If released to air it will exist predominantly in the vapor-phase and will react with photochemically produced hydroxyl radicals at an estimated half-life rate of 31 days in typical atmosphere. Direct photolysis in the troposphere is not expected to be important. The detection in rain-water suggests that atmospheric removal via wash-out is possible.

Ecotoxicity: LC_{50} Poecilia reticulata (guppy) 4.0 ppm/14 days /Conditions of bioassay not specified; LC_{50} Lepomis macrochirus (bluegill sunfish) 4.54 mg/l/24 hr; 4.3 mg/l/48 hr; 4.25 mg/l/96 hr /Static bioassay; LC_{50} Sheepshead minnow 7.5-10 mg/l/24 hr; 7.17 mg/l/48 hr; 7.4 mg/l/96 hr /Static bioassay

Henry's Law Constant: 0.0015

BCF: increases with log p

Octanol/Water Partition Coefficient: log K_{ow} = 3.39

Soil Sorption Partition Coefficient: K_{oc} = 273

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible or consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Environmentally hazardous substances, solid, n.o.s.
ID: UN3077
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 9 - Class 9
Special Provisions: 8, 146, B54, IB8, N20
Packaging: **Exceptions:** 155 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** No limit **Cargo aircraft only:** No limit
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U072 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Benzene **CAS Number:** 71-43-2
Chemical Formula: C_6H_6
Structural Chemical Formula: C_6H_6
EINECS Number: 200-753-7
ACX Number: X1001488-9
Synonyms: Benzene; BENZENE; (6)ANNULENE; BENZEEN; BENZEN; BENZIN; BENZINE; BENZOL; BENZOL 90; BENZOLE; BENZOLENE; BENZOLO; BICARBURET OF HYDROGEN; CARBON OIL; COAL NAPHTHA; CYCLOHEXATRIENE; EPA PESTICIDE CHEMICAL CODE 008801; FENZEN; MINERAL NAPHTHA; MOTOR BENZOL; NITRATION BENZENE; PHENE; PHENYL HYDRIDE; POLYSTREAM; PYROBENZOL; PYROBENZOLE
General Use: Manufacture of chemicals including styrene, dyes, and many other organic chemicals. Has been used in artificial leather, linoleum, oil cloth, airplane dopes, lacquers; as solvent for waxes, resins, oils etc.
May also be a minor component of gasoline, petrol.
Exposure should be minimized by use in closed systems.
Handling procedures and control measures should be evaluated for exposure before commencement of use in plant operations.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
benzene	71-43-2	99.9

OSHA PEL
TWA: 1 ppm; STEL: 5 ppm.

NIOSH REL
TWA: 0.1 ppm; STEL: 1 ppm.

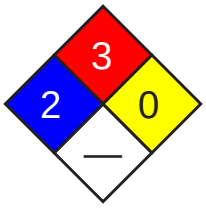
DFG (Germany) MAK
Skin.

ACGIH TLV
TWA: 0.5 ppm; STEL: 2.5 ppm; skin.

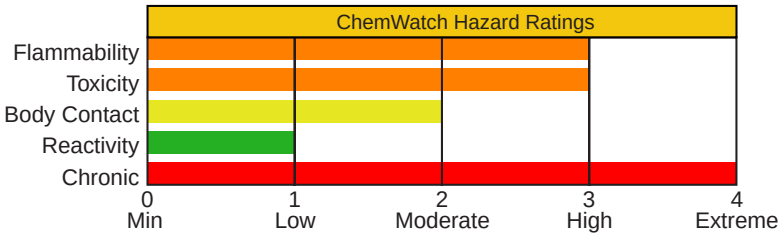
IDLH Level
500 ppm.

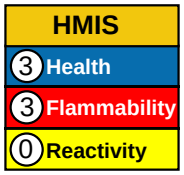
EU OEL
TWA: 1 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sweet odor. Irritating to eyes/skin/respiratory tract. Toxic. Other Acute Effects: headache, dizziness, drowsiness. Absorbed through skin. Chronic Effects: dermatitis, leukemia, bone marrow damage. Carcinogen. Reproductive effects. Flammable.

Potential Health Effects

Target Organs: blood, central nervous system (CNS), bone marrow, eyes, upper respiratory system, skin
Primary Entry Routes: inhalation, skin contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract and lungs and may be harmful if inhaled.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
Inhalation hazard is increased at higher temperatures.
The symptoms of acute exposure to high vapor concentrations include confusion, dizziness, tightening of the leg muscles and pressure over the forehead followed by a period of excitement. If exposure continues the casualty quickly becomes stupefied and lapses into a coma with narcosis.
Effects of inhalation may include nausea, vomiting headache, dizziness, drowsiness, weakness, sometimes preceded by brief periods of exhilaration, or euphoria, irritability, malaise, confusion, ataxia, staggering, weak and rapid pulse, chest pain and tightness with breathlessness, pallor, cyanosis of the lips and fingertips and tinnitus. Severe exposures may produce blurred vision, shallow, rapid breathing, delirium, cardiac arrhythmias, unconsciousness, deep anesthesia, paralysis and coma characterized by motor restlessness, tremors and hyperreflexia (occasionally preceded by convulsions). Polyneuritis and persistent nausea, anorexia, muscular weakness, headache, drowsiness, insomnia and agitation may also occur. Two-three weeks after the exposure, nervous irritability, breathlessness and unsteady gait may still persist; cardiac distress and an unusual dicoloration of the skin may be evident for up to four weeks.
Hemotoxicity is not normally a feature of acute exposures although anemia, thrombocytopenia, petechial hemorrhage, and spontaneous internal bleeding have been reported. Fatal exposures may result from asphyxia, central nervous system depression, cardiac and respiratory failure and circulatory collapse; sudden ventricular fibrillation may also be fatal.
Death may be sudden or may be delayed for 24 hours. Central nervous system, respiratory or hemorrhagic complications may occur up to five days after the exposure and may be lethal; pathological findings include respiratory inflammation with edema, and lung hemorrhage, renal congestion, cerebral edema and extensive petechial hemorrhage in the brain, pleurae, pericardium, urinary tract, mucous membrane and skin.
Exposure to toxic levels has also produced chromosome damage.

Eye: The liquid is highly discomforting to the eyes, may be harmful following absorption and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is moderately discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.
Defatting and/or drying of the skin may lead to dermatitis. Open cuts, abraded or irritated skin should not be exposed to this material.
Toxic effects may result from skin absorption.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: The liquid is discomforting to the gastrointestinal tract and may be harmful if swallowed.
Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Listed as a carcinogen; NIOSH - Listed as carcinogen; ACGIH - Class A2, Suspected human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A1, Capable of inducing malignant tumors as shown by experience with humans.

Chronic Effects: Liquid is an irritant and may cause burning and blistering of skin on prolonged exposure.
Chronic exposure may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anemia and blood changes.
Benzene is a myelotoxicant known to suppress bone-marrow cell proliferation and to induce hematologic disorders in humans and animals.
Signs of benzene-induced aplastic anemia include suppression off leukocytes (leukopenia), red cells (anemia), platelets (thromocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and hemorrhage. The most significant toxic effect is insidious and often irreversible injury to the blood forming tissue. Leukemia may develop.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1.Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.

2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.

3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.

4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.

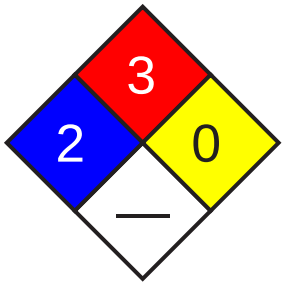
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.

6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients. Consider complete blood count. Evaluate history of exposure.

Section 5 - Fire-Fighting Measures

Flash Point: -11 °C Closed Cup
Autoignition Temperature: 562 °C
LEL: 1.3% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.

See DOT ERG



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

See DOT ERG

Large Spills: Pollutant - contain spillage. Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.

May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Storage Requirements: Store in original containers in approved flame-proof area.
No smoking, bare lights, heat or ignition sources.
DO NOT store in pits, depressions, basements or areas where vapors may be trapped. Keep containers securely sealed.
Store away from incompatible materials in a cool, dry well ventilated area.
Protect containers against physical damage and check regularly for leaks.
Observe manufacturer's storing and handling recommendations.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation usually required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection. NIOSH-approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Nitrile gloves; Neoprene gloves.
Safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >1 to 10 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 ppm: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to 1000 ppm: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range >1000 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Note: must change cartridge at beginning of each shift

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:
PE/EVAL/PE ..... Best selection
PVA ..... Best selection
TEFLON ..... Best selection

VITON ..... Best selection
VITON/NEOPRENE ..... Best selection
NITRILE+PVC ..... Poor to dangerous choice for other than short-term immersion
BUTYL ..... Poor to dangerous choice for other than short-term immersion
NITRILE ..... Poor to dangerous choice for other than short-term immersion
NEOPRENE ..... Poor to dangerous choice for other than short-term immersion
PVC ..... Poor to dangerous choice for other than short-term immersion
NATURAL RUBBER ..... Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE ..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, highly flammable liquid; floats on water. Characteristic aromatic odor. Highly volatile. Mixes with alcohol, chloroform, ether, carbon disulfide, carbon tetrachloride, glacial acetic acid, acetone and oils.

Physical State: Liquid
Odor Threshold: 4.68 ppm
Vapor Pressure (kPa): 9.95 at 20 °C
Vapor Density (Air=1): 2.77
Formula Weight: 78.12
Specific Gravity (H_2O=1, at 4 °C): 0.879 at 20 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 80.1 °C (176 °F)
Freezing/Melting Point: 5.5 °C (41.9 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.18 g/100 g of water at 25 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid reaction with oxidizing agents.

Section 11 - Toxicological Information

Toxicity
Oral (man) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 930 mg/kg
Inhalation (rat) LC_{50}: 10000 ppm/7h
Inhalation (human) LC_{Lo}: 2000 ppm/5m
Inhalation (man) TC_{Lo}: 150 ppm/1y - I
Inhalation (human) TC_{Lo}: 100 ppm
Reproductive effector in rats

Irritation
Skin (rabbit): 20 mg/24 hr - mod
Eye (rabbit): 2 mg/24 hr - SEVERE

See *RTECS* CY 1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be subject to rapid volatilization near the surface and that which does not evaporate will be highly to very highly mobile in the soil and may leach to groundwater. It may be subject to biodegradation based on reported biodegradation of 24% and 47% of the initial 20 ppm in a base-rich para-brownish soil in 1 and 10 weeks, respectively. It may be subject to biodegradation in shallow, aerobic groundwaters, but probably not under anaerobic conditions. If released to water, it will be subject to rapid volatilization; the half-life for evaporation in a wind-wave tank with a moderate wind speed of 7.09 m/sec was 5.23 hours; the estimated half-life for volatilization from a model river one meter deep flowing 1 m/sec with a wind velocity of 3 m/sec is estimated to be 2.7 hours at 20 °C. It will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms or hydrolyze. It may be subject to biodegradation based on a reported biodegradation half-life of 16 days in an aerobic river die-away test. In a marine ecosystem biodegradation occurred in 2 days after an acclimation period of 2 days and 2 weeks in the summer and spring, respectively, whereas no degradation occurred in winter. According to one experiment, it has a half-life of 17 days due to photodegradation which could contribute to removal in situations of cold water, poor nutrients, or other conditions less conductive to microbial degradation. If released to the atmosphere, it will exist predominantly in the vapor phase. Gas-phase will not be subject to direct photolysis but it will react with photochemically produced hydroxyl radicals with a half-life of 13.4 days calculated using an experimental rate constant for the reaction. The reaction time in polluted atmospheres which contain nitrogen oxides or sulfur dioxide is accelerated with the half-life being reported as 4-6 hours. Products of photooxidation include phenol, nitrophenols, nitrobenzene, formic acid, and peroxyacetyl nitrate. It is fairly soluble in water and is removed from the atmosphere in rain.

Ecotoxicity: LC_{50} Clawed toad (3-4 wk after hatching) 190 mg/l/48 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (bass) 5.8 to 10.9 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Poecilia reticulata (guppy) 63 ppm/14 days /Conditions of bioassay not specified; LC_{50} Salmo trutta (brown trout yearlings) 12 mg/l/1 hr (static bioassay); LD_{50} Lepomis macrochirus (bluegill sunfish) 20 mg/l/24 to 48 hr /Conditions of bioassay not specified; LC_{100} Tetrahymena pyriformis (ciliate) 12.8 mmole/l/24 hr /Conditions of bioassay not specified; LC_{50} Cancer magister (crab larvae) stage 1, 108 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 20 ppm/96 hr /Conditions of bioassay not specified

Henry's Law Constant: 5.3×10^{-3}

BCF: eels 3.5

Biochemical Oxygen Demand (BOD): 1.2 lb/lb, 10 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.13

Soil Sorption Partition Coefficient: K_{oc} = woodburn silt loam 31 to 143

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Benzene
ID: UN1114
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U019 Toxic Waste, Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a), per CAA Section 112 10 lb (4.535 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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(518) 842-4111

Calcium Cyanide
CAL4040

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Calcium Cyanide
CAS Number: 592-01-8
Chemical Formula: C_2CaN_2
Structural Chemical Formula: $Ca(CN)_2$
EINECS Number: 209-740-0
ACX Number: X1005026-5
Synonyms: CALCID; CALCIUM CYANIDE; CALCIUM CYANIDE MIXTURE,SOLID; CALCIUM CYANIDE,SOLID; CALCYAN; CALCYANIDE; CYANIDE OF CALCIUM; CYANOGAS; CYANURE DE CALCIUM; CYMAG; DEGESCH CALCIUM CYANIDE A-DUST; EPA PESTICIDE CHEMICAL CODE 074001
Derivation: Produced by fusing calcium cyanamide with sodium chloride to give a crude mixture of calcium cyanide and sodium cyanide or by treating powdered calcium oxide with boiling anhydrous hydrocyanic acid in the presence of an accelerator such as ammonia or water.
General Use: Used as a rodenticide; fumigant for greenhouses, grain, seed, and citrus fruits; for leaching gold and silver ores; as a stabilizer for cements; and in the manufacture of other cyanides and steel.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Calcium Cyanide	592-01-8	ca 40-58% wt (commercial preparation)

Trace Impurities: May contain up to 3% calcium carbide.

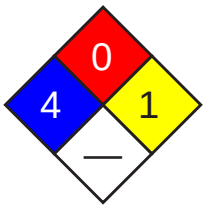
OSHA PEL
TWA: 5 mg/m^3; skin, as CN.

ACGIH TLV
Ceiling: 5 mg/m^3; skin.

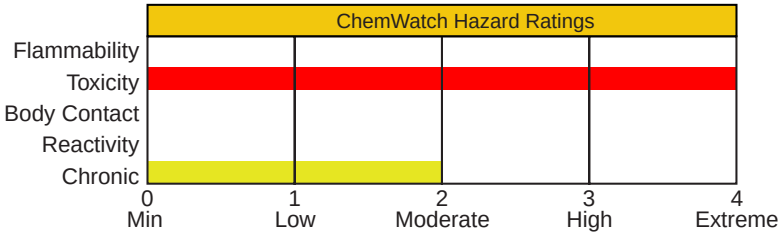
NIOSH REL
Ceiling: 4.7 ppm, 5 mg/m^3; 10 min.

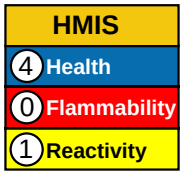
DFG (Germany) MAK
TWA: 2 mg/m^3; PEAK: 2 mg/m^3; skin; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Poison

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless crystals or white powder; slight almond odor. Poison. Other Acute Effects: chemical asphyxiant, bright-pink skin coloration of the skin, death due to respiratory arrest.

Potential Health Effects

Target Organs: Eyes, skin, blood, thyroid, cardiovascular system, central nervous system.
Primary Entry Routes: Inhalation, eye contact, skin contact/absorption, ingestion.
Acute Effects
Inhalation: Irritation of the respiratory tract, flushing, weakness, headache, confusion, dizziness. Heavy exposures can lead to difficulty breathing, convulsions and cardiac difficulties (hypertension, arrythmias, etc.). Death may occur due to respiratory arrest. Inhalation of 200 to 300 ppm can be rapidly fatal. The maximum exposure with documented survival was 500 mg/m^3.
Eye: Irritation.
Skin: Itching, redness, and irritation. Calcium cyanide can be absorbed through the skin in toxic amounts.

Ingestion: Irritation of the gastrointestinal tract, nausea and vomiting, salivation, anxiety, confusion, and dizziness. In severe cases, symptoms may progress to convulsions, paralysis, coma, cardiac arrythmias, and death due to respiratory arrest.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Thyroid disorders.

Chronic Effects: There are reports of enlarged thyroids in workers exposed to cyanide salts. It is thought that the cyanide is metabolized to thiocyanate, which competes with iodine in the body resulting in goiter. Other chronic effects include appetite loss, headache, weakness, vitamin B12 and folate abnormalities, and insomnia.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain or irritation persist.

Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.

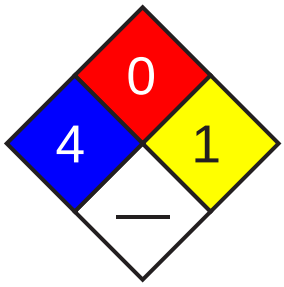
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not* induce vomiting. If available, obtain and prepare the Lilly cyanide antidote kit [Eli Lilly Co. (stock No. M76)] for use. Alternately, break an amyl nitrite ampule in a cloth and hold under nose for 15 seconds.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: If the victim is conscious, bradycardia and absence of cyanosis may be key diagnostic signs. Consider administration of amyl nitrite followed by sodium nitrite and sodium thiosulfate. Obtain blood cyanide levels.

Section 5 - Fire-Fighting Measures

See DOT ERG



Fire Diamond

Flash Point: Calcium cyanide is nonflammable itself but releases flammable hydrogen cyanide gas upon exposure to heat, water, or acids. Calcium carbide (an impurity in calcium cyanide) also releases flammable acetylene gas on contact with water.

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Flammability Classification: Nonflammable solid.

Extinguishing Media: Use agents suitable for surrounding fire, except water. Water should not be used due to formation of flammable hydrogen cyanide gas.

General Fire Hazards/Hazardous Combustion Products: Carbon and nitrogen oxide(s). Release of flammable hydrogen cyanide gas on contact with heat, water, or acids.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Sructural firefighters' protective clothing is *not* effective protection against calcium cyanide exposure.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off all heat and water sources. Cleanup personnel should protect against exposure.

Small Spills: Carefully scoop up or vacuum (with appropriate filter). *Do not* sweep!

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Damp mop with calcium or sodium hypochlorite solution.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Use only with sufficient ventilation to prevent hazardous air levels and wear appropriate PPE. Never eat, drink, or smoke in work areas. Practice good personal hygiene after using calcium cyanide, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat and water sources and incompatibles (Sec. 10).

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where possible, enclose processes to prevent dispersion of dusts into work area. Provide general or local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams of exposed workers with emphasis on the central nervous system and thyroid. Educate workers about the hazards of calcium cyanide exposure and train in safe work practices.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. One study has shown butyl rubber or polycarbonate to be suitable materials for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For <= 25 mg/m^3, wear any supplied-air respirator or any SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove calcium cyanide from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless crystals or white powder with a slight bitter almond odor (genetically undetectable by 20 to 60% of the population).

Physical State: Solid

Vapor Pressure (kPa): ~ 0 mm Hg

Formula Weight: 92.12

Specific Gravity (H_2O=1, at 4 °C): 1.853 at 68 °F (20 °C)

Freezing/Melting Point: > 350 °C (decomposes). An estimated M.P. of 640 °C was calculated (extrapolated because of decomposition).

Water Solubility: Soluble (liberates hydrogen cyanide gas).

Other Solubilities: Soluble in alcohol and very weak acids.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Calcium cyanide is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization does not occur. Exposure to heat, water, and incompatibles.

Storage Incompatibilities: Acids and water (releases flammable hydrogen cyanide gas), magnesium, fluorine, nitrates, nitrites, nitric acid; violent explosion when heated with chlorate or nitrite to 842 °F (450 °C).

Hazardous Decomposition Products: Thermal oxidative decomposition of calcium cyanide can produce carbon and nitrogen oxide(s).

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 39 mg/kg.

See *RTECS* EW0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: Sunfish, TL_m = 0.12 ppm/96 hr; Cockle, LC_{50} = > 25 ppm/48 hr.

Section 13 - Disposal Considerations

Disposal: Calcium cyanide is *not* a good candidate for incineration. Never treat with acid (hydrogen cyanide gas release). Treat with calcium or sodium hypochlorite to pH 10 to 11.5 and let stand for 24 hr. Dilute with water and await disposal. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Calcium cyanide
ID: UN1575
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB7, IP1, N79, N80
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** A **Other:** 26, 40

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed P021
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 10 lb (4.535 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Chromium
CHR4520

Section 1 - Chemical Product and Company Identification 61

Material Name: Chromium
CAS Number: 7440-47-3
Chemical Formula: Cr
Structural Chemical Formula: Cr
EINECS Number: 231-157-5
ACX Number: X1002501-1
Synonyms: CHROM; CHROME; CHROMIUM; CHROMIUM METAL
General Use: Used in the manufacture of chrome-steel or chrome-nickel-steel alloys (stainless steel); for greatly increasing resistance and durability of metals; for chrome-plating of other metals.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chromium	7440-47-3	> 99.5

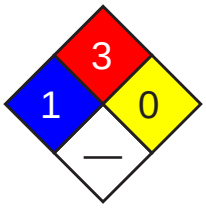
OSHA PEL
TWA: 1 mg/m^3.

NIOSH REL
TWA: 0.5 mg/m^3.

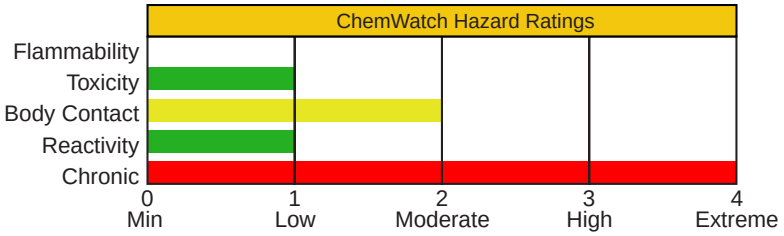
ACGIH TLV
TWA: 0.5 mg/m^3.

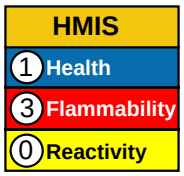
IDLH Level
250 mg/m^3 (as Cr).

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!


Explosive Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Steel-gray, lustrous metal powder; odorless. Irritating to eyes/skin/respiratory tract. Chronic Effects: lung fibrosis. Flammable. Explosive in air.

Potential Health Effects

Target Organs: respiratory system
Primary Entry Routes: inhalation, skin absorption, ingestion
Acute Effects

Inhalation: The dust may be discomforting to the upper respiratory tract and may be harmful if inhaled.
Chrome fume is irritating to the respiratory tract and lungs.
Toxic effects result from over-exposure.
Asthmatic conditions may result as a consequence of the sensitizing action of chrome VI compounds.

Eye: The dust may produce eye discomfort and abrasive eye inflammation.

Skin: The material may be mildly discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Chrome fume, as the chrome VI oxide, is corrosive to the skin and may aggravate pre-existing skin conditions such as dermatitis and eczema.
As a potential skin sensitizer, the fume may cause dermatoses to appear suddenly and without warning. Absorption of chrome VI compounds through the skin can cause systemic poisoning effecting the kidneys and liver.

Ingestion: The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

Carcinogenicity: NTP - Listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Chronic Effects: Metallic dusts generated by the industrial process give rise to a number of potential health problems. The larger particles, above 5 micron, are nose and throat irritants. Smaller particles however, may cause lung deterioration. Particles of less than 1.5 micron can be trapped in the lungs and, dependent on the nature of the particle, may give rise to further serious health consequences.

Chromium(III) is considered an essential trace nutrient serving as a component of the "glucose tolerance factor" and a cofactor for insulin action. High concentrations of chromium are also found in RNA. Trivalent chromium is the most common form found in nature.

Chronic inhalation of trivalent chromium compounds produces irritation of the bronchus and lungs, dystrophic changes to the liver and kidney, pulmonary edema, and adverse effects on macrophages. Intratracheal administration of chromium(III) oxide, in rats, increased the incidence of sarcomas, and tumors and reticulum cell sarcomas of the lung. There is inadequate evidence of carcinogenicity of chromium(III) compounds in experimental animals and humans (IARC).

Chronic exposure to hexavalent chromium compounds reportedly produces skin, eye and respiratory tract irritation, yellowing of the eyes and skin, allergic skin and respiratory reactions, diminished sense of smell and taste, blood disorders, liver and kidney damage, digestive disorders and lung damage. There is sufficient evidence of carcinogenicity of chromium(VI) compounds in experimental animals and humans to confirm these as Class 1 carcinogens (IARC).

Exposure to chromium during chrome production and in the chrome pigment industry is associated with cancer of the respiratory tract. A slight increase in gastrointestinal cancer following exposure to chromium compounds has also been reported. The greatest risk is attributed to exposure to acid- soluble, water-insoluble hexavalent chromium which occurs in roasting and refining processes. Animal studies support the idea that the most potent carcinogenic compounds are the slightly soluble hexavalent compounds.

The cells are more active in the uptake of the hexavalent forms compared to trivalent forms and this may explain the difference in occupational effect. It is the trivalent form, however, which is metabolically active and binds with nucleic acid within the cell suggesting that chromium mutagenesis first requires biotransformation of the hexavalent form by reduction.

Hexavalent chromes produce chronic ulceration of skin surfaces (quite independent of other hypersensitivity reactions exhibited by the skin).

Water-soluble chromium(VI) compounds come close to the top of any published "hit list" of contact allergens (eczematogens) producing positive results in 4 to 10% of tested individuals. On the other hand only chromium(III) compounds can bind to high molecular weight carriers such as proteins to form a complete allergen (such as a hapten). Chromium(VI) compounds cannot.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.

Encourage patient to blow nose to ensure clear breathing passages. Rinse mouth with water. Consider drinking water to remove dust from throat.

Seek medical attention if irritation or discomfort persist.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.

Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).

Wash affected areas thoroughly with water (and soap if available).

Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.

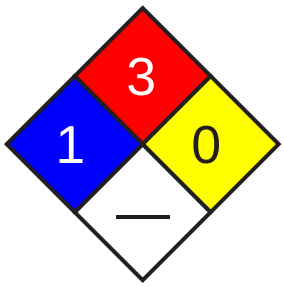
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Section 5 - Fire-Fighting Measures

Flash Point: Noncombustible Solid
Autoignition Temperature: 580 °C (cloud)
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.
General Fire Hazards/Hazardous Combustion Products: Sand, dry powder extinguishers or other inerts should be used to smother dust fires.
These are the only suitable means for extinguishing metal dust fires.
Do NOT use water.



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Clean up all spills immediately. Avoid contact with skin and eyes.
Wear impervious gloves and safety glasses.
Remove all ignition sources.
Use dry clean-up procedures and avoid generating dust.
Vacuum up or sweep up.
Place spilled material in clean, dry, sealable, labeled container.
Large Spills: Clear area of personnel.
Contact fire department and tell them location and nature of hazard.
Control personal contact by using protective equipment.
Prevent, by any means available, spillage from entering drains or water ways.
Moderate hazard.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Avoid generating dust.
Collect recoverable product into labeled containers for recycling.
Collect residues and seal in labeled drums for disposal.
Wash area down with large quantity of water and prevent runoff into drains.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Limit all unnecessary personal contact.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. When handling DO NOT eat, drink or smoke.
Always wash hands with soap and water after handling.
Avoid physical damage to containers. Use good occupational work practices.
Observe manufacturer's storing and handling recommendations.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Store in metal drums or safety cans.
Plastic container.
Metal can.
Metal drum.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Metal dusts must be collected at the source of generation as they are potentially explosive.

1. Vacuum cleaners, of flame-proof design, should be used to minimize dust accumulation.
2. Metal spraying and blasting should, where possible, be conducted in separate rooms. This minimizes the risk of supplying oxygen, in the form of metal oxides, to potentially reactive finely divided metals such as aluminum, zinc, magnesium or titanium.
3. Work-shops designed for metal spraying should possess smooth walls and a minimum of obstructions, such as ledges, on which dust accumulation is possible.
4. Wet scrubbers are preferable to dry dust collectors.
5. Bag or filter-type collectors should be sited outside the workrooms and be fitted with explosion relief doors.
6. Cyclones should be protected against entry of moisture as reactive metal dusts are capable of spontaneous combustion in humid or partially wetted state.
7. Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0. 5 meter/sec.

Special ventilation requirements apply for processes which result in the generation of barium, chromium, lead, or nickel fume and in those processes which generate ozone.

The use of mechanical ventilation by local exhaust systems is required as a minimum in all circumstances (including outdoor work).

(In confined spaces always check that oxygen has not been depleted by excessive rusting of steel or snowflake corrosion of aluminum). Local exhaust systems must be designed to provide a minimum capture velocity at the fume source, away from the worker, of 0. 5 meter/sec.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: PVC gloves; Safety footwear.
Rubber gloves.

Respiratory Protection:

Exposure Range >1 to 10 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >10 to 100 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >100 to <250 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 250 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: dust/mist filter (use P100 or consult supervisor for appropriate dust/mist filter)

Other: Overalls. Eyewash unit.

Section 9 - Physical and Chemical Properties

Appearance/General Info: A hard, brittle, lustrous, steel-grey metal which is very resistant to corrosion. Soluble in dilute sulphuric and hydrochloric acids. Welding flux grades typical sieve analysis (cumulative retention %):- 200 um 0, 150 um 10-40, 100 50-80, 75 um 80-95, 63 um 90-96, 43 um 97-100.

Physical State: Divided solid
Vapor Pressure (kPa): 0.13 at 1616 °C
Vapor Density (Air=1): 1.79
Formula Weight: 52.00
Specific Gravity (H_2O=1, at 4 °C): 7.2
Evaporation Rate: Not applicable
pH: Not applicable

pH (1% Solution): Not applicable.
Boiling Point: 2642 °C (4788 °F)
Freezing/Melting Point: 1900 °C (3452 °F)
Volatile Component (% Vol): Nil
Decomposition Temperature (°C): Not applicable
Water Solubility: Insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers, nitric oxide, potassium chlorate, sulfur dioxide, acids and strong alkalis.

Section 11 - Toxicological Information

No relevant toxicological data found at time of research.

See *RTECS* GB 4200000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: No data found.
BCF: snails 1 $x10^6$
Biochemical Oxygen Demand (BOD): 62.5 lb/lb, 5 days

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options. Follow applicable federal, state, and local regulations.
Bury residue in an authorized landfill.
Recycle containers if possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: None

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed
CERCLA 40 CFR 302.4: Listed per CWA Section 307(a) 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Coal Tar Creosote
COA9000

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Coal Tar Creosote **CAS Number:** 8001-58-9
Chemical Formula: No data found.
EINECS Number: 232-287-5
ACX Number: X1002891-0
Synonyms: AWPA #1; BRICK OIL; COAL TAR CREOSOTE; COAL TAR CRESOTE; COAL TAR OIL; CREOSOTE; CREOSOTE OIL; CREOSOTE P1; CREOSOTE,FROM COAL TAR; CREOSOTUM; CRESYLIC CREOSOTE; DEAD OIL; EPA PESTICIDE CHEMICAL CODE 025004; HEAVY OIL; HODGSONS CREOSOTE; LIQUID PITCH OIL; NAPHTHALENE OIL; PRESERV-O-SOTE; SAKRESOTE 100; TAR OIL; WASH OIL
Derivation: By distillation of coal tar produced by high-temperature carbonization of bituminous coal; by mixing strained naphthalene oil, wash oil, and strained or light anthracene oil; as a by-product of conventional coal coking.
General Use: Used mainly as a wood preservative for railroad ties, poles, fence posts, marine pilings, and other lumber for outdoor use; as a water-proofing agent, fuel oil constituent, frothing agent for mineral separation, tap hole refractory cement, and lubricant for die molds. Used only in limited quantities as an animal and bird repellent, animal dip, and insecticide (ovicide).

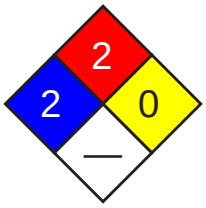
Section 2 - Composition / Information on Ingredients

Name	CAS	%
Coal tar creosote	8001-58-9	Consists of aromatic hydrocarbons, anthracene, naphthalene, and phenanthrene derivatives; some tar acids; and tar bases. Polycylic aromatic hydrocarbons make up at least 75%. * Creosote contains several carcinogenic polycyclic aromatic hydrocarbons including benz[a]anthracene, benzo[a]pyrene, and dibenz[a,h]anthracene.

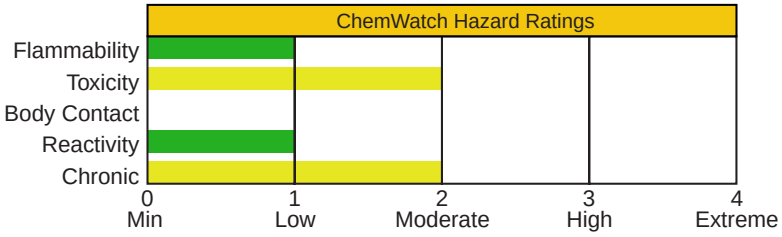
OSHA PEL **NIOSH REL**

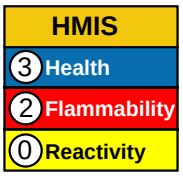
ACGIH TLV

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless (pure) or yellow to black (industrial) liquid; aromatic smoky smell. Severely irritating to eyes/skin/respiratory tract. Probable human carcinogen. Combustible.

Potential Health Effects

Target Organs: Eyes, skin, bladder, kidneys, and respiratory system
Primary Entry Routes: Inhalation, skin absorption, and skin and/or eye contact
Acute Effects *Note! Phenol and phenolic derivatives of various aromatic hydrocarbons (tar acids), present in low concentrations, are the constituents most likely to be responsible for acute toxicity.*
Inhalation: Inhalation of vapors causes moderate irritation to the nose, throat, and upper respiratory tract.
Eye: Contact with liquid causes conjunctivitis (inflammation of the eye's lining), keratitis (corneal inflammation), or corneal burns with scarring. May cause loss of vision.

Skin: Contact causes irritation, burning, itching, redness, pigment changes, dermatitis (a rash of redness and bumps), or burns. Photosensitization (worsening of rash with exposure to sunlight) may occur.

Ingestion: Causes salivation, nausea; vomiting; gastrointestinal tract irritation or bleeding; abdominal pain; rapid, thready pulse; vertigo; headaches; loss of pupillary reflexes; hypothermia; cyanosis; respiratory distress; shock and mild convulsions. Large doses may be fatal.

Carcinogenicity: NTP - Not listed; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B1, Probable human carcinogen based on epidemiologic studies; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Skin disorders.

Chronic Effects: Include dermatitis and, possibly, skin cancer or other forms of cancer. An increased risk of scrotal cancer for creosote-exposed brick makers was indicated in a worker mortality analysis. Epidemiological studies of coke oven workers reveal increased incidences of lung, bladder, prostate, pancreas, and intestinal cancer.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air, monitor for respiratory distress, and support breathing as needed.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician or ophthalmologist immediately.

Skin Contact: *Quickly* remove contaminated clothing. Prior to washing and if readily available, use undiluted polyethylene glycol 300 to 400. Wash affected area with soap and flooding amounts of water for at least 15 min. *Do not* rub or apply pressure to the affected skin, apply any oily substance or use hot water to rinse. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Rinse the mouth several times with cold water. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water. *Do not induce vomiting!* Keep victim warm and at rest.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Creosote may be detected in urine.

Special Precautions/Procedures: An exposed person should examine their skin periodically for growths, changes in warts or moles, and sores that do not heal.

Section 5 - Fire-Fighting Measures

See DOT ERG

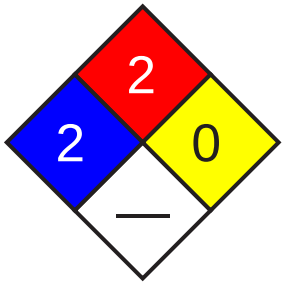
Flash Point: 165.2 °F (74 °C), Closed Cup

Autoignition Temperature: 637 °F (336 °C)

LEL: None reported.

UEL: None reported.

Flammability Classification: OSHA IIIA combustible liquid



Fire Diamond

Extinguishing Media: For small fires, use dry chemical, carbon dioxide, water spray or regular foam. For large fires, use water spray, fog or regular foam.

General Fire Hazards/Hazardous Combustion Products: Include carbon oxides. Coal tar creosote may present a vapor explosion hazard indoors, outdoors, and in sewers. Vapors may travel to an ignition source and flash back.

Fire-Fighting Instructions: If feasible and without undue risk, remove containers from fire hazard area. Otherwise use water spray to cool fire-exposed containers until well after they are extinguished. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Also, wear full protective clothing. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from area and let fire burn. Immediately leave area if you hear a rising sound from venting safety device or notice any fire-caused tank discoloration as a BLEVE (boiling liquid expanding vapor explosion) may be imminent. Isolate area for 1/2 mile in all directions if fire involves tank, rail car or tank truck. Fully decontaminate or properly dispose of personal protective clothing.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel. Isolate hazard area, deny entry, and stay upwind of spills. Shut off all ignition sources. Cleanup personnel should protect against vapor inhalation and skin and eye contact.

Small Spills: Take up with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers for later disposal.

Large Spills: Consider initial downwind evacuation for at least 300 meters (1000 feet). For large spills, dike far ahead of liquid spill for later disposal. Water spray may reduce vapor. *Do not* release into sewers or waterways. Use nonsparking tools during clean-up.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation and skin and eye contact. Use ventilation sufficient to reduce airborne exposures to nonhazardous levels (Sec. 2). Wear protective gloves, goggles, and clothing to avoid contact. Wear respiratory protection when necessary (Sec. 8). Consult your industrial hygienist. Practice good personal hygiene procedures to avoid inadvertently ingesting this material. Keep away from ignition sources.
Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in a cool, dry, well-ventilated area away from heat and ignition sources. Store coal tar creosote as close to area of use as possible to minimize transporting distance. Avoid physical damage to containers.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Enclose all operations and/or ventilate at the site of release to avoid vapor dispersion into the work area. To prevent static sparks, electrically ground and bond all containers and equipment. Provide general or local exhaust ventilation systems equipped with high-efficiency particulate filters to maintain airborne concentrations below OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Preplacement and periodic medical examinations of exposed workers emphasizing respiratory, skin, liver, and kidney disorders, including comprehensive work and medical history, physical examination, CXR, PFTs, urinalysis, LFT, and sputum cytology as the attending physician considers appropriate. Educate workers about the health and safety hazards associated with coal tar creosote.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent any skin contact. With breakthrough times of >8 hr, butyl rubber, Teflon, and Viton are recommended materials. Frequent change of protective garments is an additional protective measure. Wear protective eyeglasses or chemical safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. (The following respirator recommendations are for coal tar pitch volatiles.) For concentrations above the NIOSH REL or at any detectable concentrations, wear a SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode; or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure-demand or other positive-pressure mode. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air- purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless (pure) or yellow to black (industrial); aromatic smoky smell.

Physical State: Oily liquid

Specific Gravity (H_2O=1, at 4 °C): 1.07 to 1.08 at 68 °F (20 °C)

Boiling Point: 381 to 752 °F (194 to 400 °C)

Water Solubility: Slightly soluble

Other Solubilities: Soluble in alcohol; ether; glycerin; dimethyl sulfate; fixed or volatile oils; in solution of fixed alkali hydroxides.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Coal tar creosote is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Avoid excessive heat and contact with chlorosulfonic acid.

Storage Incompatibilities: Creosote oil mixed with chlorosulfonic acid in a closed container causes an increase in temperature and pressure.

Hazardous Decomposition Products: Thermal oxidative decomposition of coal tar creosote can produce carbon oxides and thick, black, acrid smoke.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 725 mg/kg.
Mouse, oral, LD_{50}: 433 mg/kg.

Other Effects:
Tumorgenicity, mouse, oral: 2 g/kg administered on gestational days 5-9 produced maternal effects and fetotoxicity.
Reproductive Effects - Hamster, ovary cell: 10 mg/L induced sister chromatid exchange.
Tumorigenicity: Mouse, skin, 99 g/kg/33 weeks administered intermittently produced tumors on skin and appendages (carcinogenic by RTECS criteria).
S. typhimurium: 20 µg/plate (-S9) produced mutations.

See *RTECS* GF8615000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: TL50, goldfish (*Carassius auratus*), 3.51 ppm/24 hr (60:40) mixture of creosote and coal tar; TL50, rainbow trout (*Salmo gairdneri*), 3.72 ppm/24 hr (60:40) mixture of creosote and coal tar; LD_{50}, bob white quail (*Colinus virginianus*), 1,260 ppm/8 days (60:40) mixture of creosote and coal tar.
Octanol/Water Partition Coefficient: log K_{ow} = 1.0

Section 13 - Disposal Considerations

Disposal: Coal tar creosote is a good candidate for rotary kiln and fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Corrosive liquids, n.o.s.
ID: UN1760
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols: G - Technical Name Required
Label Codes: 8 - Corrosive
Special Provisions: A7, B10, T14, TP2, TP27
Packaging: **Exceptions:** None **Non-bulk:** 201 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** 0.5 L **Cargo aircraft only:** 2.5 L
Vessel Stowage: **Location:** B **Other:** 40

Shipping Name and Description: Corrosive liquids, n.o.s.
ID: UN1760
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols: G - Technical Name Required
Label Codes: 8 - Corrosive
Special Provisions: B2, IB2, T11, TP2, TP27
Packaging: **Exceptions:** 154 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Corrosive liquids, n.o.s.
ID: UN1760
Hazard Class: 8 - Corrosive material
Packing Group: III - Minor Danger
Symbols: G - Technical Name Required
Label Codes: 8 - Corrosive

Special Provisions: IB3, T7, TP1, TP28
Packaging: **Exceptions:** 154 **Non-bulk:** 203 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Not listed
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Ethylbenzene **CAS Number:** 100-41-4
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_5 \bullet C_2H_5$
EINECS Number: 202-849-4
ACX Number: X1003016-1
Synonyms: AETHYLBENZOL; BENZENE,ETHYL-; EB; ETHYL BENZENE; ETHYLBENZEEN; ETHYLBENZENE; ETHYLBENZOL; ETILBENZENE; ETYLOBENZEN; PHENYLETHANE
General Use: Used in the manufacture of cellulose acetate, styrene and synthetic rubber; solvent or diluent; component of automotive and aviation gasoline.
Component of many petroleum hydrocarbon solvents, thinners.
The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
ethylbenzene	100-41-4	>95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

ACGIH TLV
TWA: 100 ppm; STEL: 125 ppm.

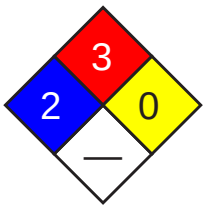
EU OEL
TWA: 100 ppm; STEL: 200 ppm.

NIOSH REL
TWA: 100 ppm (435 mg/m^3); STEL: 125 ppm (545 mg/m^3).

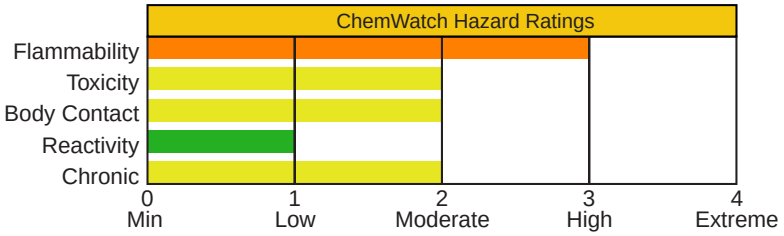
IDLH Level
800 ppm (10% LEL).

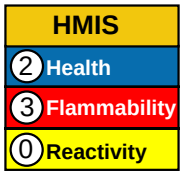
DFG (Germany) MAK
Skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; pungent odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: chest constriction, vertigo, narcosis, cramps, respiratory paralysis. Chronic Effects: fatigue, sleepiness, headache, blood disorders, lymphocytosis. Flammable.

Potential Health Effects

Target Organs: eyes, respiratory system, skin, central nervous system (CNS), blood
Primary Entry Routes: inhalation, skin contact, eye contact
Acute Effects
Inhalation: The vapor is discomforting to the upper respiratory tract.
Inhalation hazard is increased at higher temperatures.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Inhalation of vapor may aggravate a pre-existing respiratory condition such as asthma, bronchitis, emphysema.
When humans were exposed to the 100 and 200 ppm for 8 hours about 45-65% is retained in the body. Only traces of unchanged ethyl benzene are excreted in expired air following termination of inhalation exposure.
Humans exposed to concentrations of 23-85 ppm excreted most of the retained dose in the urine (mainly as metabolites).
Guinea pigs that died from exposure had intense congestion of the lungs and generalized visceral hyperemia. Rats exposed for three days at 8700 mg/m^3 (2000 ppm) showed changes in the levels of dopamine and noradrenaline in various parts of the brain.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Two drops of the material in to the conjunctival sac produced only slight irritation of the conjunctival membrane but no corneal injury.

Skin: The liquid is discomforting to the skin if exposure is prolonged and is capable of causing skin reactions which may lead to dermatitis.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
The mean rate of absorption of liquid ethyl benzene applied to 17.3 cm2 area of the forearm of seven volunteers for 10-15 minutes was determined to be 38 mg/cm2/hr. Immersion of the whole hand in aqueous solutions of ethyl benzene (112-156 mg/l) for 1 hour yielded mean absorption rates of 118 and 215.7 ug/cm2/hr. The rate of absorption is thus greater than that of aniline, benzene, nitrobenzene, carbon disulfide and styrene.
Repeated application of the undiluted product to the abdominal area of rabbits (10-20 applications over 2-4 weeks) resulted in erythema, edema and superficial necrosis. The material did not appear to be absorbed through the skin in sufficient quantity to produce outward signs of toxicity.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid may produce considerable gastrointestinal discomfort and may be harmful or toxic if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.
Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Industrial workers exposed to a maximum level of ethyl benzene of 0.06 mg/l (14 ppm) reported headaches and irritability and tired quickly. Functional nervous system disturbances were found in some workers employed for over 7 years whilst other workers had enlarged livers.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Rinse mouth out with plenty of water. DO NOT induce vomiting.
Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink.
Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

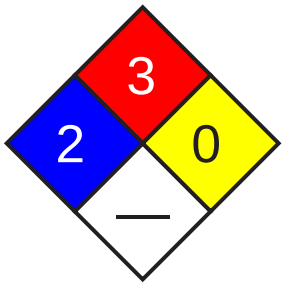
Note to Physicians: For acute or short-term repeated exposures to petroleum distillates or related hydrocarbons:

1. Primary threat to life from pure petroleum distillate ingestion and/or inhalation is respiratory failure.
2.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
3.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance
4.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
5.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
6.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.

Section 5 - Fire-Fighting Measures

Flash Point: 12.8 °C Closed Cup
Autoignition Temperature: 432 °C
LEL: 1.6% v/v
UEL: 7% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
May emit clouds of acrid smoke.

See DOT ERG



Fire Diamond

Fire Incompatibility: Avoid contamination with oxidizing agents i.e. nitrates, oxidizing acids, chlorine bleaches, pool chlorine etc. as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

See DOT ERG

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear. Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves or Nitrile gloves.
Protective footwear.
Respiratory Protection:
Exposure Range >100 to <800 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 800 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black
Other: Overalls. Eyewash unit.
Glove Selection Index:
VITON ..... Best selection
TEFLON ..... Best selection

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid; floats on water. Aromatic solvent odor. Soluble in alcohol, benzene, carbon tetrachloride and ether.

Physical State: Liquid
Odor Threshold: 8.7 to 870.0 mg/m^3
Vapor Pressure (kPa): 1.333 at 25.9 °C
Vapor Density (Air=1): 3.66
Formula Weight: 106.17
Specific Gravity (H_2O=1, at 4 °C): 0.8670 at 20 °C
Evaporation Rate: Fast

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 136.2 °C (277 °F) at 760 mm Hg
Freezing/Melting Point: -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.01% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 3500 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm/8h
Inhalation (rat) LC_{Lo}: 4000 ppm/4h
Intraperitoneal (mouse) LD_{50}: 2642 mg/kg~
Dermal (rabbit) LD_{50}: 17800 mg/kg~
Liver changes, utheral tract, effects on fertility, specific developmental abnormalities (musculoskeletal system) recorded.
NOTE: Substance has been shown to be mutagenic in various assays, or belongs to a family of chemicals producing damage or change to cellular DNA.

Irritation

Skin (rabbit): 15 mg/24h mild
Eye (rabbit): 500 mg - SEVERE

See *RTECS* DA 0700000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, it exist predominantly in the vapor phase based on its vapor pressure where it will photochemically degrade by reaction with hydroxyl radicals (half-life 0.5 to 2 days) and partially return to earth in rain. It will not be subject to direct photolysis. Releases into water will decrease in concentration by evaporation and biodegradation. The time for this decrease and the primary loss processes will depend on the season, and the turbulence and microbial populations in the particular body of water. Representative half-lives are several days to 2 weeks. Some may be adsorbed by sediment but significant bioconcentration in fish is not expected to occur based upon its octanol/water partition coefficient. It is only adsorbed moderately by soil. It will not significantly hydrolyze in water or soil.

Ecotoxicity: LC_{50} Cyprinodon variegatus (sheepshead minnow) 275 mg/l 96 hr in a static unmeasured bioassay; LC_{50} Pimephales promelas (fathead minnow) 12.1 mg/l/96 hr (confidence limit 11.5 - 12.7 mg/l), flow-through bioassay with measured concentrations, 26.1 °C, dissolved oxygen 7.0 mg/l, hardness 45.6 mg/l calcium carbonate, alkalinity 43.0 mg/l; Toxicity threshold (cell multiplication inhibition test): Pseudomonas putida (bacteria) 12 mg/l ; LC_{50} Palaemonetes pugio (grass shrimp, adult) 14,400 ug/l/24 hr in a static unmeasured bioassay; LC_{50} Palaemonetes pugio (grass shrimp, larva) 10,200 ug/l/24 hr in a static unmeasured bioassay; Toxicity threshold (cell multiplication inhibition test): Microcystis aeruginosa (algae) 33 mg/l; Scenedesmus quadricauda (green algae) > 160 mg/l

Henry's Law Constant: 8.44×10^{-3}

BCF: goldfish 1.9

Biochemical Oxygen Demand (BOD): theoretical 2.8%, 5 days

Octanol/Water Partition Coefficient: log $K_{ow} = 3.15$

Soil Sorption Partition Coefficient: $K_{oc} = 164$

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Ethylbenzene
ID: UN1175
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per CWA Section 307(a) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
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(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: n-Hexane **CAS Number:** 110-54-3
Chemical Formula: C_6H_{14}
Structural Chemical Formula: $H_3C(CH_2)_4CH_3$
EINECS Number: 203-777-6
ACX Number: X1001498-5
Synonyms: DIPROPYL; ESANI; GETTYSOLVE-B; HEKSAN; HEXANE; N-HEXANE; N-HEXANE; HEXANEN; HEXYL HYDRIDE; NORMAL HEXANE; NORMAL-HEXANE; SKELLYSOLVE-B; SKELLYSOLVE B
General Use: An incidental component of many aliphatic solvent mixes used as lacquer, paint and enamel thinners, also in ink reducers and cleaning solvents.
Also used for solvent extraction of oil seeds and in pesticide residue analysis and gas chromatography.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
n-hexane	110-54-3	> 95

OSHA PEL
TWA: 500 ppm; 1800 mg/m^3.

NIOSH REL
TWA: 50 ppm (180 mg/m^3).

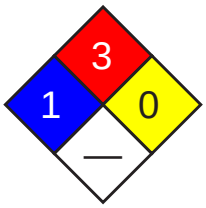
DFG (Germany) MAK
TWA: 50 ppm; PEAK: 400 ppm.

ACGIH TLV
TWA: 50 ppm; skin.

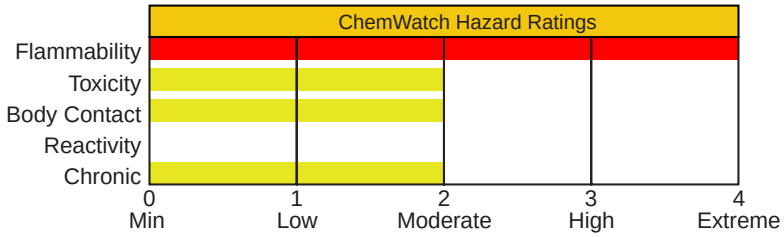
IDLH Level
1100 ppm (10% LEL).

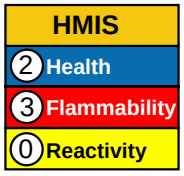
EU OEL
TWA: 72 mg/m^3 (20 ppm).

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless, volatile liquid; sweet/gasoline odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, fatigue, muscle weakness, hallucinations. Chronic Effects: muscle weakness, motor loss, sensory disturbances. Flammable.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, central nervous system (CNS), peripheral nervous system
Primary Entry Routes: inhalation, skin contact/absorption, eyes, ingestion
Acute Effects
Inhalation: The vapor is discomforting and harmful to the upper respiratory tract.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.

The vapor is irritating to the eyes and may cause smarting, painand redness.
The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid is discomforting to the skin and is capable of causing skin reactions which may lead to dermatitis.
Toxic effects may result from skin absorption.

Ingestion: The liquid is highly discomforting and harmful if swallowed.
Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.
Considered an unlikely route of entry in commercial/industrial environments.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Chronic inhalation or skin exposure to n-hexane may cause peripheral neuropathy, which is damage to nerve ends in extremities, e.g. fingers, with loss of sensation and characteristic thickening. Nerve damage has been documented with chronic exposures of greater than 500 ppm.
Improvement in condition does not immediately follow removal from exposure and symptoms may progress for two or three months. Recovery may take a year or more depending on severity of exposure, and may not always be complete.
Exposure to n-hexane with methyl ethyl ketone (MEK) will accelerate the appearance of damage, but MEK alone will not cause the nerve damage.
Other isomers of hexane do not cause nerve damage.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Following acute or short-term repeated exposures to n-hexane:
1.Large quantities of n-hexane are expired by the lungs after vapor exposure (50-60%). Humans exposed to 100 ppm demonstrate an n-hexane biological half life of 2 hours.
2. Initial attention should be directed towards evaluation and support of respiration. Cardiac dysrhythmias are a potential complication.
INGESTION:
1.Ipecac syrup should be considered for ingestion of pure hexane exceeding 2-3 mL/kg. Extreme caution must be taken to avoid aspiration since small amounts of n-hexane intratracheally, produce a severe chemical pneumonitis
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

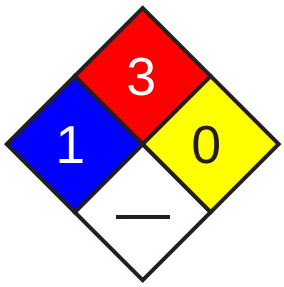
Determinant	Index	Sampling Time	Comments
2,5-hexanedione in urine	5 mg/gm creatinine	End of shift	NS
n-Hexane in end-exhaled air			SQ

NS: Non-specific determinant; Metabolite observed following exposure to other materials.
SQ: Semi-quantitative determinant; Interpretation may be ambiguous - should be used as a screening test or confirmatory test.

Section 5 - Fire-Fighting Measures

Flash Point: -22 °C
Autoignition Temperature: 225 °C
LEL: 1.1% v/v
UEL: 7.5% v/v
Extinguishing Media: Dry chemical powder. Foam.
Carbon dioxide.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO). May emit clouds of acrid smoke.
Fire Incompatibility: Avoid reaction with oxidizing agents.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Pollutant - clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so.
Water spray or fog may be used to disperse/absorb vapor.
Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable products into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

See DOT ERG

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.

Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Avoid concurrent exposure to materials containing Methyl Ethyl Ketone MEK

Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Polyethylene gloves. Wear chemical protective gloves, eg. PVC.
Wear safety footwear.
Do NOT use this product to clean the skin.

Respiratory Protection:
Exposure Range >500 to <1100 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask
Exposure Range 1100 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Note: poor warning properties

Other: Overalls. Eyewash unit. Barrier cream. Skin cleansing cream.

Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
SARANEX-23 2-PLY	Best selection
VITON	Best selection
VITON/CHLOROBUTYL	Best selection
TEFLON	Satisfactory; may degrade after 4 hours continuous immersion
NITRILE	Satisfactory; may degrade after 4 hours continuous immersion
NEOPRENE	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
PVC	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with typical paraffinic odor; floats on water. Mixes with most other organic solvents, chloroform, ether, alcohol. A very volatile liquid, it readily forms explosive vapor /air mixes.

Physical State: Liquid
Odor Threshold: 0.076 ppm
Vapor Pressure (kPa): 13.33
Vapor Density (Air=1): 2.97
Formula Weight: 86.17
Specific Gravity (H_2O=1, at 4 °C): 0.6603 at 20 °C
pH: Not applicable
pH (1% Solution): Not applicable
Boiling Point: 68.89 °C (156 °F)
Freezing/Melting Point: -100 °C (-148 °F) to -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: 0.002% by weight

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and ignition source. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity
Oral (rat) LD_{50}: 28710 mg/kg
Inhalation (human) TC_{Lo}: 190 ppm/8W
Inhalation (rat) LD_{50}: 48000 ppm/4h

Irritation
Eye (rabbit): 10 mg - mild

See *RTECS* MN9275000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Photolysis, hydrolysis or bioconcentration are not expected to be an important environmental fate processes. Biodegradation may occur in soil and water; however, volatilization and adsorption are expected to be far more important fate processes. A K_{oc} range of 1250 to 4100 indicates a low to slight mobility class in soil. In aquatic systems it may partition from the water column to organic matter contained in sediments and suspended materials. A Henry's Law constant of 1.81 atm-cu m/mole at 25 °C suggests rapid volatilization from environmental waters. The volatilization half-lives from a model river and a model pond, the latter considers the effect of adsorption, have been estimated to be 2.7 hr and 6.8 days, respectively. It is expected to exist entirely in the vapor-phase in ambient air. Reactions with photochemically produced hydroxyl radicals in the atmosphere have been shown to be important (average estimated half-life of 2.9 days). Data also suggests that nighttime reactions with nitrate radicals may contribute to atmospheric transformation, especially in urban environments.
Ecotoxicity: No data found.
Henry's Law Constant: calculated at 1.81
BCF: estimated at 2.24 to 2.89
Biochemical Oxygen Demand (BOD): theoretical 0%, 7 days
Octanol/Water Partition Coefficient: log K_{ow} = 4.11
Soil Sorption Partition Coefficient: K_{oc} = estimated at 1250 to 4100

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Hexanes
ID: UN1208
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** E **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Issue Date: 2006-06

Chromium Trioxide
CHR3640

Section 1 - Chemical Product and Company Identification 61

Material Name: Chromium Trioxide
CAS Number: 1333-82-0
Chemical Formula: CrO_3
Structural Chemical Formula: CrO_3
EINECS Number: 215-607-8
ACX Number: X1002507-3
Synonyms: 5CHROMIUM TRIOXIDE,ANHYDROUS; ANHYDRIDE CHROMIQUE; ANIDRIDE CROMICA; CHROME (TRIOXYDE DE); CHROMIA; CHROMIC ACID; CHROMIC ACID,SOLID; CHROMIC ACID,SOLUTION; CHROMIC ANHYDRIDE; CHROMIC OXIDE; CHROMIC TRIOXIDE; CHROMIC (VI) ACID; CHROMIC VI ACID; CHROMIC (VI) OXIDE (1:3); CHROMIC(VI) ACID; CHROMIUM OXIDE; CHROMIUM OXIDE [CRO3]; CHROMIUM (6+) TRIOXIDE; CHROMIUM TRIOXIDE; CHROMIUM(6+) TRIOXIDE; CHROMIUM VI OXIDE; CHROMIUM(VI) OXIDE; CHROMSAEUREANHYDRID; CHROMTRIOXID; CHROOMTRIOXYDE; CHROOMZUURANHYDRIDE; CROMO(TRIOSSIDO DI); MONOCHROMIUM OXIDE; MONOCHROMIUM TRIOXIDE; PURATRONIC; PURATRONIC CHROMIUM TRIOXIDE
General Use: Chromium plating; copper stripping; aluminum anodizing; corrosion inhibitor; photography; lithography; textile printing; tanning and dyeing. Manufacture of dyes, pigments, electric cells, explosives, matches.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
chromium trioxide	1333-82-0	>99.8

OSHA PEL
TWA: 5 µg/m^3; Action level: 2.5 µg/m^3; Ceiling: 0.1 mg/m^3; as CrO_3.

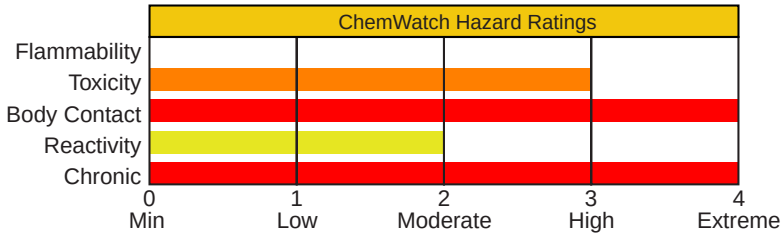
ACGIH TLV
TWA: 0.05 mg/m^3. *Chromium (VI) inorganic compounds - Water soluble (as Cr)*

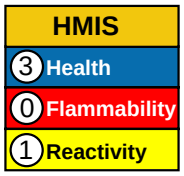
NIOSH REL
TWA: 0.001 mg/m^3.

IDLH Level
15 mg/m^3 {as Cr(VI)}.

Section 3 - Hazards Identification

Fire Diamond





ANSI Signal Word
Danger!


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Dark, purplish-red powder. Corrosive, causes severe burns to eyes/skin/respiratory tract. Toxic. Chronic Effects: dermatitis, tooth erosion, nasal septum perforation. Strong oxidizer.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, liver, kidneys, teeth
Primary Entry Routes: skin contact eye contact with the material and inhalation of generated dust

Acute Effects

Inhalation: Not normally a hazard due to nonvolatile nature of product. Generated dust may be highly discomforting and may be corrosive to the upper respiratory tract.
Chronic inhalation exposure may result in nasal ulceration and/or perforation of nasal septum.
Chromium VI exposures have been related to higher incidence of lung cancer.
Chrome fume is irritating to the respiratory tract and lungs.
Toxic effects result from over-exposure.
Asthmatic conditions may result as a consequence of the sensitizing action of chrome VI compounds.
Eye: The material is extremely corrosive to the eyes and is capable of causing severe damage with loss of sight.
Skin: The material is extremely corrosive to the skin and is capable of causing severe burns, even minor exposure is highly discomforting and may cause blisters or burns or skin sensitization. Bare unprotected skin should not be exposed to this material.
Symptoms of exposure may be delayed.
Toxic effects may result from skin absorption. Skin contact may result in severe irritation, particularly to broken skin.
Ulceration known as "chrome ulcers" may develop. Chrome ulcers and skin cancer are significantly related.
Ingestion: Considered an unlikely route of entry in commercial/industrial environments. The material is extremely corrosive and may be fatal if swallowed.

Carcinogenicity: NTP - Class 1, Known to be a carcinogen; IARC - Group 1, Carcinogenic to humans; OSHA - Not listed; NIOSH - Listed as carcinogen; ACGIH - Class A1, Confirmed human carcinogen; EPA - Class A, Human carcinogen; MAK - Class A2, Unmistakably carcinogenic in animal experimentation only.

Chronic Effects: Sensitization may give severe responses to very low levels of exposure, i.e., hypersensitivity. Sensitized persons should not be allowed to work in situations where exposure may occur.

Chromium(III) is considered an essential trace nutrient serving as a component of the "glucose tolerance factor" and a cofactor for insulin action. High concentrations of chromium are also found in RNA. Trivalent chromium is the most common form found in nature.

Chronic inhalation of trivalent chromium compounds produces irritation of the bronchus and lungs, dystrophic changes to the liver and kidney, pulmonary edema, and adverse effects on macrophages. There is inadequate evidence of carcinogenicity of chromium(III) compounds in experimental animals and humans (IARC).

Chronic exposure to hexavalent chromium compounds reportedly produces skin, eye and respiratory tract irritation, yellowing of the eyes and skin, allergic skin and respiratory reactions, diminished sense of smell and taste, blood disorders, liver and kidney damage, digestive disorders and lung damage. There is sufficient evidence of carcinogenicity of chromium(VI) compounds in experimental animals and humans to confirm these as Class 1 carcinogens (IARC).

Exposure to chromium during chrome production and in the chrome pigment industry is associated with cancer of the respiratory tract. A slight increase in gastrointestinal cancer following exposure to chromium compounds has also been reported. The greatest risk is attributed to exposure to acid-soluble, water-insoluble hexavalent chromium which occurs in roasting and refining processes. Animal studies support the idea that the most potent carcinogenic compounds are the slightly soluble hexavalent compounds.

Hexavalent chromes produce chronic ulceration of skin surfaces.

Water-soluble chromium(VI) compounds come close to the top of any published "hit list" of contact allergens (eczematogens) producing positive results in 4 to 10% of tested individuals.

Section 4 - First Aid Measures

Inhalation: • If dust is inhaled, remove to fresh air.
• Encourage patient to blow nose to ensure clear breathing passages.
• Ask patient to rinse mouth with water but to not drink water.
• Seek immediate medical attention.
• If fumes or combustion products are inhaled, remove to fresh air.
• Lay patient down. Keep warm and rested.
• Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
• If breathing is shallow or has stopped, ensure clear airway and apply resuscitation, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
• Transport to hospital or doctor.

Eye Contact: DO NOT delay. If this product comes in contact with the eyes:
• Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water.
• Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
• Transport to hospital or doctor without delay.
• Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: DO NOT delay. If this product comes in contact with the skin:
• Immediately flush body and clothes with large amounts of water, using safety shower if available.
• Quickly remove all contaminated clothing, including footwear.

• Wash affected areas with water (and soap if available) for at least 15 minutes.
• Transport to hospital or doctor.

Ingestion: DO NOT delay. Rinse mouth out with plenty of water. Contact a Poison Control Center. If swallowed, do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: • Acute chromic acid ingestion cause acute gastroenteritis, hepatic necrosis, bleeding and acute tubular necrosis with renal failure. The efficacy of British Anti-Lewisite hemodialysis and exchange transfusion has not been established.

• Primary irritation, including chrome ulceration, may be treated with ointments comprising calcium-sodium-EDTA. This, together with the use of frequently renewed dressings, will ensure rapid healing of any ulcer which may develop. The mechanism of action involves the reduction of Cr(VI) to Cr(III) and subsequent chelation; the irritant effect of Cr(III)/protein complexes is thus avoided.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
Extinguishing Media: Use extinguishing media suitable for surrounding fire.
General Fire Hazards/Hazardous Combustion Products: Noncombustible.

See DOT ERG

Fire Diamond

• Will not burn but increases intensity of fire.
• Heating may cause expansion or decomposition leading to violent rupture of containers.
• Heat affected containers remain hazardous.
• Contact with combustibles such as wood, paper, oil or finely divided metal may cause ignition, combustion or violent decomposition.
• May emit irritating, poisonous or corrosive fumes., i.e., metal oxides. Decomposes at approx 200°C. liberating oxygen gas.

Fire Incompatibility: Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous. Avoid mixing with combustible materials and reducing agents. Can produce intense heat and toxic fumes.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard. May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Cool fire-exposed containers with water spray from a protected location. Use water delivered as a fine spray to control the fire and cool adjacent area. If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

See DOT ERG

Small Spills: • Clean up all spills immediately.
• No smoking, bare lights, ignition sources.
• Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials, as ignition may result.
• Avoid breathing dust or vapors and all contact with skin and eyes.
• Control personal contact by using protective equipment.
• Contain and absorb spill with dry sand, earth, inert material or vermiculite
• Do not use sawdust as fire may result.
• Scoop up solid residues and seal in labeled drums for disposal.
• Neutralize/decontaminate area.

Large Spills: • Clear area of personnel and move upwind.
• Contact fire department and tell them location and nature of hazard.
• May be violently or explosively reactive.
• Wear full body protective clothing with breathing apparatus.
• Prevent, by any means available, spillage from entering drains or waterways.
• Consider evacuation (or protect in place).
• No smoking, flames or ignition sources.
• Increase ventilation.
• Contain spill with sand, earth or other clean, inert materials.
• Never use organic absorbents such as sawdust, paper, cloth; as fire may result.
• Avoid any contamination by organic matter.
• Use spark-free and explosion-proof equipment.
• Collect any recoverable product into labeled containers for possible recycling.
• Do not mix fresh with recovered material.
• Collect residues and seal in labeled drums for disposal.
• Wash area and prevent runoff into drains.
• Decontaminate equipment and launder all protective clothing before storage and reuse.
• If contamination of drains or waterways occurs advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: • Avoid personal contact and inhalation of dust, mist or vapors.
• Provide adequate ventilation.
• Always wear protective equipment and wash off any spillage from clothing.
• Keep material away from light, heat, flammables or combustibles.
• Keep cool, dry and away from incompatible materials.
• Avoid physical damage to containers.
• Do not repack or return unused portions to original containers. Withdraw only sufficient amounts for immediate use.
• Contamination can lead to decomposition leading to possible intense heat and fire.
• When handling, never smoke, eat or drink.
• Always wash hands with soap and water after handling.
• Observe manufacturer's storage and handling directions.
Recommended Storage Methods: Steel drum or glass container.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
• Local exhaust ventilation is required where solids are handled as powders or crystals; even when particulates are relatively large, a certain proportion will be powdered by mutual friction.
• Exhaust ventilation should be designed to prevent accumulation and recirculation of particulates in the workplace.
• If in spite of local exhaust an adverse concentration of the substance in air could occur, respiratory protection should be considered. Such protection might consist of: (a): particle dust respirators, if necessary, combined with an absorption cartridge; (b): filter respirators with absorption cartridge or canister of the right type; (c): fresh-air hoods or masks.
• Build-up of electrostatic charge on the dust particle, may be prevented by bonding and grounding.
• Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Personal Protective Clothing/Equipment:

Eyes: Full face shield. Safety glasses. or chemical goggles. Do not wear contact lenses. Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Ensure that there is ready access to eye wash unit.

Hands/Feet: Wear gloves and use scoop/tongs/tools. Elbow length PVC gloves or rubber gloves. Protective footwear.

Respiratory Protection:

Exposure Range >0.1 to 1 mg/m^3: Air Purifying, Negative Pressure, Half Mask
Exposure Range >1 to 10 mg/m^3: Air Purifying, Negative Pressure, Full Face
Exposure Range >10 to <15 mg/m^3: Supplied Air, Constant Flow/Pressure Demand, Full Face
Exposure Range 15 to unlimited mg/m^3: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: magenta (P100)

Note: as chromium VI compounds

Other: Overalls.
Rubber apron or impervious protective clothing.
Ensure there is ready access to an emergency shower.
Ensure that there is ready access to eye wash unit.

Glove Selection Index:

BUTYL ..... Best selection
NATURAL RUBBER..... Best selection
NITRILE+PVC ..... Best selection
PVC..... Best selection
NITRILE ..... Satisfactory; may degrade after 4 hours continuous immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Dark red odorless crystals or flakes.
Physical State: crystals, powder
Vapor Pressure (kPa): Reid; very low
Vapor Density (Air=1): not applicable
Formula Weight: 99.99
Specific Gravity (H_2O=1, at 4 °C): 2.7
Evaporation Rate: non volatile
pH: acid
pH (1% Solution): < 1 at 10%
Freezing/Melting Point: 197 °C (386.6 °F)
Volatile Component (% Vol): none at 38 °C
Decomposition Temperature (°C): 200 °C
Water Solubility: miscible

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Avoid contamination with combustible materials as ignition may result. Presence of incompatible materials. Storage in unsealed containers. Product is considered stable under normal handling conditions. Hazardous polymerization will not occur.

Storage Incompatibilities: Avoid contamination of water, foodstuffs, feed or seed. Store away from sawdust, finely divided combustible materials and organic materials/compounds. Do not use aluminum, galvanized or tin-plated containers.

Section 11 - Toxicological Information

Toxicity

Oral (rat) LD_{50}: 80 mg/kg

Inhalation (human) TC_{Lo}: 0.11 mg/m^3

Irritation

Skin (human): corrosive

See *RTECS* GB6650000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: LC_{50}Ophryotrocha diadema (polychaete worm); 7,500 ug/l as chromium and Ctendrilus seratus (polychaete worm) 4,300 ug/l as chromium; static unmeasured method; LC_{50}Capitella captata (polychaete worm) 8,000 ug/l as chromium (larval) and 5,000 ug/l as chromium (adult); static unmeasured method; EC_{50}Salmo gairdneri (rainbow trout, embryo larva) 190 ug/l as chromium/28 days, with a water hardness of 101 mg/l as calcium carbonate; Toxic Effect: death and deformity. /Conditions of bioassay not specified; Toxic threshold, Daphnia magna 0.016-0.7 ppm

BCF: none

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: • Recycle wherever possible. Special hazard may exist - specialist advice may be required.
- Consult manufacturer for recycling options.
- Follow applicable local, state, and federal regulations.
- Treat and neutralize residue at an approved site.
- Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.
- Puncture containers to prevent reuse and bury at an authorized landfill. Reduce Cr(VI) to Cr(III) using meta-bisulfite, neutralize with lime and reclaim sludge.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Chromium trioxide, anhydrous
ID: UN1463
Hazard Class: 5.1 - Oxidizer
Packing Group: II - Medium Danger
Symbols:
Label Codes: 5.1 - Oxidizer, 8 - Corrosive
Special Provisions: IB8, IP4

Packaging:	**Exceptions:** None	**Non-bulk:** 212	**Bulk:** 242
Quantity Limitations:	**Passenger aircraft/rail:** 5 kg		**Cargo aircraft only:** 25 kg
Vessel Stowage:	**Location:** A	**Other:**	

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed as Compound per CWA Section 307(a), per CAA Section 112
SARA 40 CFR 372.65: Listed as Compound
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Methanol
MET1440

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Methanol **CAS Number:** 67-56-1
Chemical Formula: CH_4O
Structural Chemical Formula: CH_3OH
EINECS Number: 200-659-6
ACX Number: X1001287-2
Synonyms: ALCOHOL,METHYL; ALCOOL METHYLIQUE; ALCOOL METILICO; CARBINOL; X-CIDE 402 INDUSTRIAL BACTERICIDE; COAT-B1400; COLONIAL SPIRIT; COLONIAL SPIRITS; COLUMBIAN SPIRIT; COLUMBIAN SPIRITS; EPA PESTICIDE CHEMICAL CODE 053801; EUREKA PRODUCTS CRIOSINE DISINFECTANT; EUREKA PRODUCTS,CRIOSINE; FREERS ELM ARRESTER; IDEAL CONCENTRATED WOOD PRESERVATIVE; METANOL; METANOLO; METHANOL; METHYL ALCOHOL; METHYL HYDRATE; METHYL HYDROXIDE; METHYLALKOHOL; METHYLOL; METYLOWY ALKOHOL; MONOHYDROXYMETHANE; PMC REJEX-IT F-40ME; PYROLIGNEOUS SPIRIT; PYROXYLIC SPIRIT; PYROXYLIC SPIRITS; SURFLO-B17; WILBUR-ELLIS SMUT-GUARD; WOOD ALCOHOL; WOOD NAPHTHA; WOOD SPIRIT
Derivation: Prepared by wood pyrolysis; non-catalytic oxidation of hydrocarbons; as a by-product in the fisher-tropsch synthesis; or by reduction of carbon monoxide.
General Use: Used as an industrial solvent; starting material for organic synthesis; antifreeze for windshield washer fluid; in fuel antifreezes; gasoline octane booster; fuel for stoves; extractant for oils; denaturing ethanol; softening agent; food additive; in paint, varnish removers, and embalming fluids; in the manufacture of photographic film, celluloid, textile soap, wood stains, coated fabrics, shatterproof glass, paper coating, waterproofing formulations, artificial leather, dyes.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Methanol	67-56-1	ca 100% vol

Trace Impurities: (Grade A): Acetone and aldehydes < 30 ppm, acetic acid < 30 ppm

OSHA PEL
TWA: 200 ppm; 260 mg/m^3.

ACGIH TLV
TWA: 200 ppm; STEL: 250 ppm; skin.

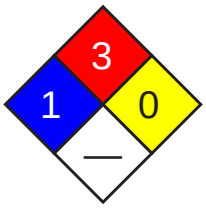
EU OEL
TWA: 260 mg/m^3 (200 ppm).

NIOSH REL
TWA: 200 ppm (260 mg/m^3); STEL: 250 ppm (325 mg/m^3); skin.

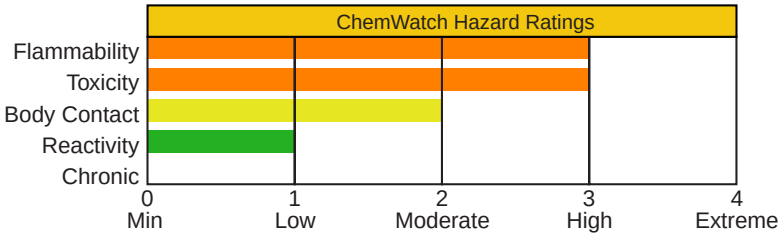
IDLH Level
6000 ppm.

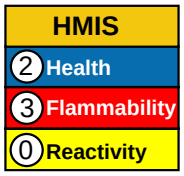
DFG (Germany) MAK
TWA: 200 ppm; PEAK: 800 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; slight alcohol odor when pure or disagreeably pungent odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: headache, visual disturbance, blindness, respiratory failure. Chronic Effects: reproductive effects reported in animal testing. Flammable; moderate explosion hazard.

Potential Health Effects

Target Organs: Eyes, skin, central nervous system (CNS), gastrointestinal (GI) tract, respiratory system
Primary Entry Routes: Inhalation, ingestion, skin and/or eye contact/absorption
Acute Effects
Inhalation: Irritation, breathing difficulty, headache, drowsiness, vertigo, light-headedness, nausea, vomiting, acidosis (decreased blood alkalinity), visual disturbance, and at high concentrations, CNS damage, convulsions, circulatory collapse, respiratory failure, coma and blindness can result from inhalation of methanol vapor. Concentration >= 200 ppm may cause headache; 50,000 ppm can cause death within 1-2 hrs.
Eye: Contact with liquid may result in irritation, inflamed lids, light sensitization, and superficial lesions.
Skin: Contact may cause irritation, dermatitis, swelling, scaling, and systemic effects.
Ingestion: GI irritation and systemic effects. Symptoms may be delayed 18-48 hours. Fatal dose - 2 to 8 ounces.
Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.
Medical Conditions Aggravated by Long-Term Exposure: None reported.
Chronic Effects: Exposure to methanol vapors has caused conjunctivitis, headache, giddiness, insomnia, GI disturbance, impaired vision. CNS damage is also likely. Methanol is slowly eliminated from the body; exposure is considered cumulative over the short term.

Section 4 - First Aid Measures

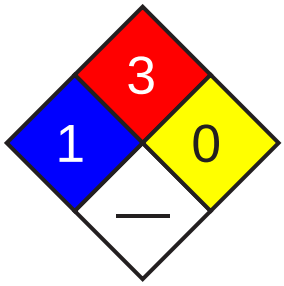
See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed.
Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 minutes. Consult a physician or ophthalmologist if pain or irritation develops.
Skin Contact: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the *conscious and alert* person drink 1 to 2 glasses of water, then induce vomiting.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Note to Physicians: Follow emesis with rehydration, correction of acidosis, and folate to enhance formate oxidation. Consider IV administration of ethanol (if blood methanol >20 mg/dL) to show metabolic oxidation of methanol. Assay formic acid in urine, blood pH and plasma bicarbonate.

Section 5 - Fire-Fighting Measures

See DOT ERG

Flash Point: 54 °F (12 °C), Closed Cup
Burning Rate: 1.7 mm/min
Autoignition Temperature: 867 °F (464 °C)
LEL: 6.0% v/v
UEL: 36% v/v
Flammability Classification: OSHA Class IB Flammable Liquid.
Extinguishing Media: Use dry chemical, carbon dioxide, water spray, fog or alcohol-resistant foam. A water spray may be used to cool fire-exposed containers, and flush spills away from ignition sources.
General Fire Hazards/Hazardous Combustion Products: Heating methanol to decomposition can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes. Can form explosive mixtures in the air. The heavier-than-air vapors of methanol may travel along low-lying surfaces to distant sources of ignition and flash back to the material source. Containers may explode in heat of fire.



Fire Diamond

Fire-Fighting Instructions: *Do not* scatter material with any more water than needed to extinguish fire. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Isolate spill area for at least 330-660 feet (100-200 m) in all directions. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). Ground all equipment used when handling this product. *Do not* touch or walk through spilled material. Stop leak if you can do it without risk. Prevent entry into waterways, sewers, basements or confined areas. A vapor suppressing foam may be used to reduce vapors.
Small Spills: Absorb with earth, sand or other non-combustible material and transfer to containers for later disposal.

Use clean non-sparking tools to collect absorbed material.

Large Spills: Dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Ground all equipment. Use non-sparking tools.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid vapor inhalation, and skin and eye contact. Use only with ventilation sufficient to reduce airborne concentrations to non-hazardous levels (see Sec. 2). Wear protective gloves, goggles, and clothing (see Sec. 8). Keep away from heat and ignition sources. Ground and bond all containers during transfers to prevent static sparks. Use non-sparking tools to open and close containers.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed container in cool, well-ventilated area, away from heat, ignition sources and incompatibles (see Sec. 10). Equip drums with self-closing valves, pressure vacuum bungs, and flame arrestors.

Regulatory Requirements: Follow applicable OSHA regulations. Also 29 CFR 1910.106 for Class 1B Flammable Liquids.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: To prevent static sparks, electrically ground and bond all containers and equipment used in shipping, receiving, or transferring operations. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Enclose operations and/or provide local explosion-proof exhaust ventilation at the site of chemical release. Where possible, transfer methanol from drums or other storage containers to process containers. Minimize sources of ignition in surrounding areas.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets of butyl rubber, Teflon, Viton, Saranex, 4H, Responder, Trellchem HPS, or Tychem 10000 (Breakthrough Time (BT) >8 hr) to prevent skin contact. Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol and CPF 3 may degrade after contact and are not recommended. Wear splash-proof chemical safety goggles, and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/ NIOSH-approved respirator. For concentrations <= 2000 ppm, use a supplied air respirator; <= 5000 ppm, supplied air (SA) respirator in continuous flow mode; <= 6000 ppm, SA respirator with tight-fitting face mask operated in continuous flow mode, or SCBA with full facepiece, or SA respirator with full facepiece; > IDLH/unknown/emergency, SCBA with full facepiece operated in pressure-demand or other positive-pressure mode, or SA respirator with full facepiece operated in pressure-demand or other positive-pressure mode in combination with auxiliary SCBA operated in pressure-demand or other positive-pressure mode. For escape, use an appropriate escape-type SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen- deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Colorless; slight alcohol odor when pure, disagreeably pungent odor when crude.

Physical State: Liquid

Odor Threshold: 13.1150 to 26840 mg/m^3

Vapor Pressure (kPa): 127 mm Hg at 77 °F (25 °C)

Vapor Density (Air=1): 1.11

Bulk Density: 6.59 lbs/gal at 68 F (20 °C)

Formula Weight: 32.04

Density: 0.796 g/mL at 59 °F (15 °C)

Specific Gravity (H_2O=1, at 4 °C): 0.81 at 0 °C/4 °C

Refractive Index: 1.3292 at 68 °F (20 °C)

pH: Slightly acidic

Boiling Point: 148 °F (64.7 °C) at 760 mm Hg

Freezing/Melting Point: -144.04 °F (-97.8 °C)

Viscosity: 0.614 mPa sec

Surface Tension: 22.61 dynes/cm

Ionization Potential (eV): 10.84 eV

Water Solubility: Miscible

Other Solubilities: Ethanol, acetone, benzene, chloroform, DMSO, ether, ketones, most organic solvents.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Methanol is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. Vapor inhalation, oxidizers.

Storage Incompatibilities: Include beryllium dihydride, metals (potassium, magnesium), oxidants (barium perchlorate, bromine, chlorine, hydrogen peroxide, sodium hypochlorite, phosphorus trioxide), potassium tertbutoxide, carbon tetrachloride and metals, chloroform and heat, diethyl zinc, alkyl aluminum salts, acetyl bromide, chloroform and sodium hydroxide, cyanuric chloride, nitric acid, chromic anhydride, lead perchlorate.

Hazardous Decomposition Products: Thermal oxidative decomposition of methanol can produce carbon oxides (CO_x), formaldehyde, acrid smoke, and irritating fumes.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 5628 mg/kg.

Human, oral, LD_{Lo}: 428 mg/kg produced toxic effects: behavioral - headache; lungs, thorax, or respiration - other changes.

Human, oral, LD_{Lo}: 143 mg/kg produced optic nerve neuropathy, dyspnea, nausea or vomiting.

Acute Inhalation Effects:

Rat, inhalation, LC_{50}: 64000 ppm/4 hr.

Human, inhalation, TC_{Lo}: 300 ppm produced visual field changes, headache; lungs, thorax, or respiration - other changes.

Acute Skin Effects:

Rabbit, skin, LD_{50}: 15800 mg/kg.

Monkey, skin, LD_{Lo}: 393 mg/kg.

Irritation Effects:

Rabbit, standard Draize test: 100 mg/24 hr resulted in moderate irritation.

Rabbit, standard Draize test: 20 mg/24 hr resulted in moderate irritation.

Other Effects:

Rat, oral: 10 µmol/kg resulted in DNA damage.

Rat, inhalation: 50 mg/m^3/12 hr/13 weeks intermittently produced degenerative changes to brain and coverings; muscle contraction or spasticity.

Rat, inhalation: 2610 ppm/6 hr/4 weeks intermittently produced toxic effects: endocrine - changes in spleen weight.

Multiple Dose Toxicity Effects - Rat, oral: 12 g/kg/8 weeks intermittently produced toxic effects: behavioral - ataxia; behavioral - alteration of operant conditioning.

Human, lymphocyte: 300 mmol/L resulted in DNA inhibition.

Rat (female), oral: 7500 mg/kg, administered during gestational days 17-19 produced effects on newborn - behavioral.

Rat (female), oral: 35295 mg/kg administered during gestational days 1-15 produced effects on the fertility index; pre implantation mortality; and post-implantation mortality.

Rat (female), inhalation: 20000 ppm/7 hr, administered during gestational days 1-22 produced specific developmental abnormalities - musculoskeletal system; cardiovascular (circulatory) system; urogenital system.

Rat (male), oral: 200 ppm/20 hr, 78 weeks prior to mating produced paternal effects - testes, epididymis, sperm duct.

See *RTECS* PC1400000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Bioconcentration (BCF, estimated at 0.2) is not expected to be significant. Physical removal from air can occur via rainfall. Relatively rapid evaporation from dry surfaces is likely to occur. If released to the atmosphere, it degrades via reaction with photochemically produced hydroxyl radicals with an approximate half-life of 17.8 days. If released to water or soil, biodegradation is expected to occur. A low K_{oc} indicates little sorption and high mobility in the soil column.

Ecotoxicity: Trout, LC_{50}: 8,000 mg/L/48 hr; *Pimephales promelas* (fathead minnow) LC_{50}: 29.4 g/L/96 hr.

Henry's Law Constant: 4.55 $x10^{-6}$ atm-m^3/mole at 77 °F (25 °C)

Octanol/Water Partition Coefficient: log K_{ow} = -0.77

Soil Sorption Partition Coefficient: K_{oc} = 0.44

Section 13 - Disposal Considerations

Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Methanol
ID: UN1230
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols: + I

Label Codes: 3 - Flammable Liquid, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: IB2, T7, TP2
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:** 40

Shipping Name and Description: Methanol
ID: UN1230
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols: D - Domestic transportation

Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T7, TP2
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 1 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U154 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per RCRA Section 3001 5000 lb (2268 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
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Naphthalene
NAP1620

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Naphthalene **CAS Number:** 91-20-3
Chemical Formula: $C_{10}H_8$
EINECS Number: 202-049-5
ACX Number: X1001294-7
Synonyms: ALBOCARBON; CAMPHOR TAR; DEZODORATOR; FAULDING NAPHTHALENE FLAKES; MIGHTY 150; MIGHTY RD1; MOTH BALLS; MOTH FLAKES; MOTHBALLS; NAFTALEN; NAPHTHALENE; NAPHTHALIN; NAPHTHALINE; NAPHTHENE; TAR CAMPHOR; WHITE TAR
Derivation: From coal tar; from petroleum fractions after various catalytic processing operations.
General Use: Used as a moth repellent, an antiseptic, toilet bowl deodorant, heat transfer agent, fungicide, smokeless powder, cutting fluid, lubricant, wood preservative; an intermediate for naphthol, phthalic anhydride, chlorinated naphthalenes, Tertralin, Decalin, naphthyl and naphthol derivatives, and dyes; in synthetic resins, synthetic tanning, textile chemicals, scintillation counters, and emulsion breakers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Naphthalene	91-20-3	ca 100% wt.

Grade - By melting point, 165 °F (74 °C) min (crude) to greater than 174 °F (79 °C) (refined); scintillation 176-177 °F (80-81 °C)

OSHA PEL
TWA: 10 ppm; 50 mg/m^3.

NIOSH REL
TWA: 10 ppm (50 mg/m^3); STEL: 15 ppm (75 mg/m^3).

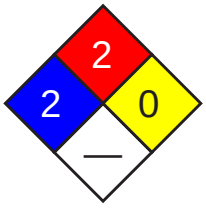
DFG (Germany) MAK
Skin.

ACGIH TLV
TWA: 10 ppm; STEL: 15 ppm; skin.

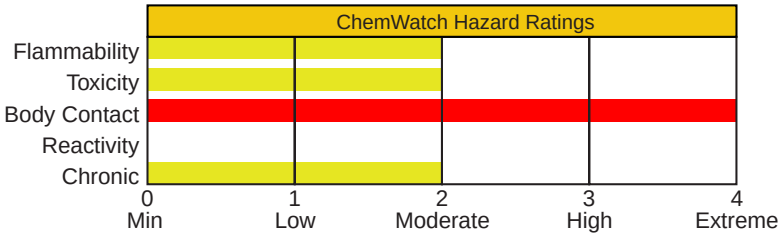
IDLH Level
250 ppm.

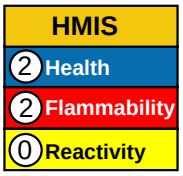
EU OEL
TWA: 10 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White crystalline solid; "moth ball" or coal-tar odor. Irritating to eyes/skin/respiratory tract. Toxic by ingestion. Combustible solid. Dust may form explosive mixtures in air.

Potential Health Effects

Target Organs: Blood (red blood cell effects), eyes, skin, central nervous system (CNS), liver and kidneys
Primary Entry Routes: Inhalation, skin absorption, skin and/or eye contact
Acute Effects
Inhalation: Vapor inhalation causes headache, confusion, nausea, sometimes vomiting, loss of appetite, extensive sweating, dysuria (painful urination), hematuria (blood in the urine), and hemolysis (destruction of red blood cells).
Eye: Irritation, conjunctivitis, and corneal injury upon prolonged contact.
Skin: Irritation and hypersensitivity dermatitis.

Ingestion: Unlikely. However, ingestion causes irritation of the mouth and stomach, hemolytic anemia with hepatic and renal lesions and vesical congestion, kidney failure, hematuria, jaundice, depression of CNS, nausea, vomiting, abdominal pain, blue face, lips, or hands, rapid and difficult breathing, headache, confusion, excitement, malaise, fever, perspiration, urinary tract pain, dizziness, convulsions, coma, and death. Symptoms may appear 2 to 4 hours after exposure.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Diseases of the blood, liver and kidneys; individuals with a hereditary deficiency of the enzyme glucose-6-phosphate dehydrogenase in red blood cells are particularly susceptible to the hemolytic properties of naphthalene metabolites.

Chronic Effects: May cause optical neuritis, corneal injuries, cataracts, kidney damage. There are two reports of naphthalene crossing the placenta in humans.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: Remove exposed person to fresh air and support breathing as needed. Contact a physician immediately if symptoms of systemic poisoning are present.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist if pain, irritation, swelling, or photophobia persist.

Skin Contact: Quickly remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area thoroughly with soap and water. For reddened or blistered skin, consult a physician. Contact a physician immediately if symptoms of systemic poisoning are present.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, have the conscious and alert person drink 1 to 2 glasses of water, then induce vomiting. Contact a physician immediately.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Obtain baseline CBC, electrolytes, liver and renal function rests, glucose-6-phosphatase dehydrogenase level, urinalysis, and benzidine dipstick to check for hemoglobinuria. Urinary metabolite, 1-naphthol or mercapturic acid, may help confirm the diagnosis.

Section 5 - Fire-Fighting Measures

See DOT ERG

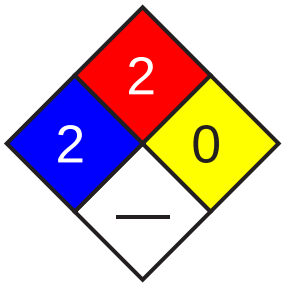
Flash Point: 174 °F (79 °C) OC; 190 °F (88 °C) CC

Autoignition Temperature: 979 °F (526 °C)

LEL: 0.9% v/v

UEL: 5.9% v/v

Flammability Classification: Combustible solid



Fire Diamond

Extinguishing Media: Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water or foam may cause frothing. Use water spray to keep fire-exposed containers cool.

General Fire Hazards/Hazardous Combustion Products: Toxic vapors including carbon monoxide. Volatile solid that gives off flammable vapors when heated. Dust may explode in air if an ignition source is provided.

Fire-Fighting Instructions: Move containers from the fire area if it can be done without risk. Otherwise cool fire-exposed containers until well after the fire is extinguished. Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Wear full protective clothing. Structural clothing is permeable, remain clear of smoke, water fall out, and water run off.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel, evacuate all unnecessary personnel, remove heat and ignition sources. Isolate and ventilate area, deny entry, stay upwind. Stop leak if you can do it without risk. Use spark-proof tools and explosion proof equipment. Cleanup personnel should wear personal protective equipment to protect against exposure.

Small Spills: Do not sweep! Carefully scoop up or vacuum (with a HEPA filter). Absorb liquid spill with an inert, noncombustible absorbent such as sand or vermiculite.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. Do not release into sewers or waterways.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: To avoid vapor inhalation use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Avoid skin and eye contact. Wear personal protective clothing and equipment to prevent any contact with skin and eyes (see Sec. 8). Practice good personal hygiene procedures to prevent inadvertently ingesting this material.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed, explosion-proof containers in a cool, well-ventilated area away from heat, ignition sources, and incompatibles (see Sec. 10). May be stored under nitrogen gas. Protect containers against physical damage. Use monitoring equipment to measure the extent of vapor present in any storage facility containing naphthalene because of potential fire and explosion hazards.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose operations to avoid vapor and dust dispersion into the work area. Ventilate at the site of chemical release. During the fractional distillation of naphthalene and in any operation entailing the heating or volatilization of naphthalene, enclosed apparatus should be employed. Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Educate workers about the health and safety hazards associated with naphthalene. Train in work practices which minimize exposure. Consider preplacement and periodic medical exams with emphasis on the eyes, skin, liver, kidneys, CBC (RBC count, WBC count, differential count of a stained smear, hemoglobin, and hematocrit), and urinalysis including at a minimum specific gravity, albumin, glucose, and a microscopic examination on centrifuged sediment.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Teflon is recommended. *Do not* use butyl rubber, natural rubber, neoprene or polyvinyl chloride. Wear chemical dust-proof safety goggles and face shield, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove naphthalene from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White volatile flakes, cakes, cubes, spheres, or powder; strong coal-tar or moth ball odor.

Physical State: Crystalline solid

Odor Threshold: < 0.3 ppm

Vapor Pressure (kPa): 0.05 mm Hg at 68 °F (20 °C); 1.0 mm Hg at 127 °F (53 °C)

Formula Weight: 128.2

Density: 1.145 g/cm^3 at 68 °F (20 °C)

Boiling Point: 424 °F (218 °C)

Freezing/Melting Point: 176 °F (80.2 °C)

Water Solubility: Insoluble [31.7 mg/L at 68 °F (20 °C)]

Other Solubilities: Benzene, absolute alcohol; very soluble in ether, chloroform, carbon disulfide, hydronaphthalenes, fixed and volatile oils

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Naphthalene is stable at room temperature in closed containers under normal storage and handling conditions. It volatilizes at room temperature. Hazardous polymerization cannot occur. Exposure to heat and ignition sources, incompatibles.

Storage Incompatibilities: Include aluminum chloride, benzoyl chloride, chromic acid, chromium trioxide, oxidizers. Explosive reaction with dinitrogen pentaoxide. Melted naphthalene will attack some forms of plastics.

Hazardous Decomposition Products: Thermal oxidative decomposition of naphthalene can produce toxic fumes including carbon monoxide.

Section 11 - Toxicological Information

Acute Oral Effects:
Rat, oral, LD_{50}: 490 mg/kg.
Mouse, oral, LD_{50}: 533 mg/kg.
Human (child), oral, LD_{Lo}: 100 mg/kg.

Acute Inhalation Effects:
Rat, inhalation, LC_{50}: >340 mg/m^3 produced lacrimation and somnolence.

Irritation Effects:
Rabbit, eye, standard Draize test: 100 mg produced mild irritation.
Rabbit, skin, open Draize test: 495 mg produced mild irritation.

Other Effects:
Rat, oral: 4500 mg/kg administered on gestational days 6-15 produced fetotoxicity and other developmental abnormalities.
Man, unreported, LD_{Lo}: 74 mg/kg.
Mouse, inhalation: 30 ppm/6 hr/2 yr administered intermittently produced toxic effects: tumorigenic - neoplastic by RTECS criteria; lungs, thorax, or respiration - tumors.
Hamster, ovary: 15 mg/L induced sister chromatid exchange.

See *RTECS* QJ0525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to the atmosphere, naphthalene rapidly photodegrades with a half-life of 3-8 hr. Volatilization, photolysis, adsorption, and biodegradation are important loss mechanisms for naphthalene discharged into water. Depending on local conditions, the half-lives range from a couple of days to a few months. If released on land, it is adsorbed moderately to soil, undergoes biodegradation; but in some cases biodegradation may still occur if conditions are aerobic. Bioconcentration occurs to a moderate extent, but is a temporary problem since depuration and metabolism readily proceed in aquatic organisms.

Ecotoxicity: *Oncorhynchus gorbuscha* (pink salmon): 1.37 ppm/96 hr at 39 °F (4 °C). *Pimephales promelas* (fathead minnow): 7.76 mg/L/24 hr.

Octanol/Water Partition Coefficient: log K_{ow} = 3.30

Section 13 - Disposal Considerations

Disposal: Consider rotary kiln or fluidized bed incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Naphthalene, crude *or* Naphthalene, refined
ID: UN1334
Hazard Class: 4.1 - Flammable solid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 4.1 - Flammable Solid
Special Provisions: A1, IB8, IP3
Packaging: **Exceptions:** 151 **Non-bulk:** 213 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 25 kg **Cargo aircraft only:** 100 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Listed U165 Toxic Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

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Material Safety Data Sheet Collection
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Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Nitric Acid **CAS Number:** 7697-37-2
Chemical Formula: HNO_3
Structural Chemical Formula: HNO_3
EINECS Number: 231-714-2
ACX Number: X1002177-5
Synonyms: ACIDE NITRIQUE; ACIDO NITRICO; AQUA FORTIS; AZOTIC ACID; AZOTOWY KWAS; ENGRAVER'S ACID; ENGRAVERS ACID; HYDROGEN NITRATE; KYSELINA DUSICNE; NITAL; NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH >70% NITRIC ACID; NITRIC ACID OTHER THAN RED FUMING WITH NOT >70% NITRICACID; NITROUS FUMES; NITRYL HYDROXIDE; RED FUMING NITRIC ACID (RFNA); SALPETERSAURE; SALPETERZUUROPLOSSINGEN; WHITE FUMING NITRIC ACID (WFNA)
General Use: Manufacture of organic and inorganic nitrates and nitro compounds for fertilizers, dye intermediates and many organic chemicals.
Used for etching and cleaning metals.
Operators should be trained in procedures for safe use of this material.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
nitric acid	7697-37-2	>95

OSHA PEL
TWA: 2 ppm; 5 mg/m^3.

ACGIH TLV
TWA: 2 ppm; STEL: 4 ppm.

EU OEL
STEL: 2.6 mg/m^3 (1 ppm).

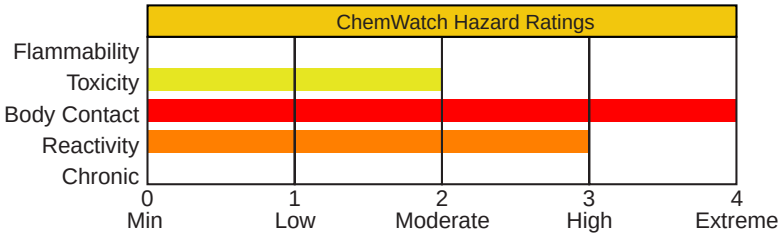
NIOSH REL
TWA: 2 ppm (5 mg/m^3); STEL: 4 ppm (10 mg/m^3).

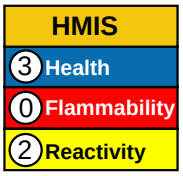
IDLH Level
25 ppm.

DFG (Germany) MAK
TWA: 2 ppm; PEAK: 2 ppm.

Section 3 - Hazards Identification

Fire Diamond





ANSI Signal Word

Danger!


Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear to yellow fuming liquid; acrid, suffocating odor. Corrosive. Other Acute Effects: lung damage. Chronic Effects: tooth erosion, bronchitis. Strong oxidizer.

Potential Health Effects

Target Organs: eyes, skin, respiratory system, teeth
Primary Entry Routes: inhalation, ingestion, skin contact, eye contact
Acute Effects
Inhalation: The vapor is extremely discomforting and corrosive to the upper respiratory tract and lungs and the material presents a hazard from a single acute exposure or from repeated exposures over long periods.
Inhalation hazard is increased at higher temperatures.
Reactions may occur following a single acute exposure or may only appear after repeated exposures.

Reactions may not occur on exposure but response may be delayed with symptoms only appearing many hours later.
The material may produce respiratory tract irritation which produces an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system. Unlike most organs the lung can respond to a chemical insult or agent by first trying to remove or neutralize the irritant and then repairing the damage. The repair process, which initially developed to protect mammalian lungs from foreign matter and antigens, may however, cause further damage the lungs when activated by hazardous chemicals. The result is often the impairment of gas exchange, the primary function of the lungs.
Inhalation of nitric acid mist or fumes at 2 to 25 ppm over an 8 hour period may cause pulmonary irritation and symptoms of lung damage.
Only several minutes of exposure to concentrated atmosphere i.e. 200 ppm may cause severe pulmonary damage and even fatality. Death may be delayed for several days.
Exposure to nitric acid fumes (with concurrent inhalation of nitrogen dioxide and nitric oxide) may elicit prompt irritation of the upper respiratory tract leading to coughing, gagging, chest pain, dyspnea, cyanosis if concentrations are sufficiently high and duration of exposure sufficiently long, pulmonary edema.

Eye: The liquid is extremely corrosive to the eyes and contact may cause rapid tissue destruction and is capable of causing severe damage with loss of sight.
The vapor is extremely discomforting to the eyes and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The material may produce moderate eye irritation leading to inflammation.
Repeated or prolonged exposure to irritants may produce conjunctivitis.
Eye contact with concentrated acid may give no pain, whilst diluted solution causes intense pain and both can cause permanent eye damage or blindness. Burns may result in shrinkage of the eyeball, symblepharon (adhesions between tarsal and bulbar conjunctivae), permanent corneal opacification, and visual impairment leading to blindness.

Skin: The liquid is extremely corrosive to the skin and contact may cause tissue destruction with severe burns.
Bare unprotected skin should not be exposed to this material.
The vapor is highly discomforting to the skin.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.
Skin contact causes yellow discoloration of the skin, blisters and scars that may not heal. The skin may be stained bright-yellow or yellowish brown due to the formation of xanthoproteic acid. Dilute solutions may harden the epithelium without producing overt corrosion.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The material is extremely corrosive if swallowed and is capable of causing burns to mouth, throat, esophagus, with extreme discomfort, pain and may be fatal.
Even a small amount causes severe corrosion of the stomach, burning pain, vomiting and shock, possibly causing non-healing scarring of the gastrointestinal tract and stomach. Death may be delayed 12 hours to 14 days or to several months. Such late fatalities are attributed to a chemical lobular pneumonitis secondary to aspiration. Survivors show stricture of the gastric mucosa and subsequent pernicious anemia.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Chronic Effects: Prolonged or repeated overexposure to low concentrations of vapor may cause chronic bronchitis, corrosion of teeth, even chemical pneumonitis.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Immediately transport to hospital or doctor. DO NOT delay.

Skin Contact: Immediately flush body and clothes with large amounts of water, using safety shower if available.
Quickly remove all contaminated clothing, including footwear.
Wash affected areas with water (and soap if available) for at least 15 minutes. Transport to hospital or doctor. DO NOT delay.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
Immediately transport to hospital or doctor. DO NOT delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to strong acids:

1.Airway problems may arise from laryngeal edema and inhalation exposure.
Treat with 100% oxygen initially.
2.Respiratory distress may require cricothyroidotomy if endotracheal intubation is contraindicated by excessive swelling.
3. Intravenous lines should be established immediately in all cases where there is evidence of circulatory compromise.
4.Strong acids produce a coagulation necrosis characterized by formation of a coagulum (eschar) as a result of the desiccating action of the acid on proteins in specific tissues.

INGESTION:

1.Immediate dilution (milk or water) within 30 minutes post-ingestion is recommended.
2.Do not attempt to neutralize the acid since exothermic reaction may extend the corrosive injury.
3.Be careful to avoid further vomiting since re-exposure of the mucosa to the acid is harmful. Limit fluids to one or two glasses in an adult.
4.Charcoal has no place in acid management.
5.Some authors suggest the use of lavage within 1 hour of ingestion.

SKIN:

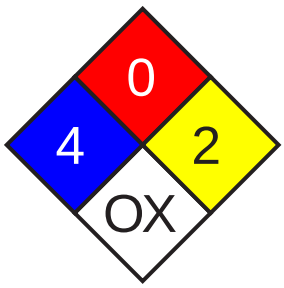
1.Skin lesions require copious saline irrigation. Treat chemical burns as thermal burns with non-adherent gauze and wrapping.
2.Deep second-degree burns may benefit from topical silver sulfadiazine.

EYE:

1.Eye injuries require retraction of the eyelids to ensure thorough irrigation of the conjunctival cul-de-sacs. Irrigation should last at least 20-30 minutes. Do not use neutralizing agents or any other additives. Several liters of saline are required.
2.Cycloplegic drops (1% cyclopentolate for short-term use or 5% homatropine for longer term use), antibiotic drops, vasoconstrictive agents, or artificial tears may be indicated dependent on the severity of the injury.
3.Steroid eye drops should only be administered with the approval of a consulting ophthalmologist.

Section 5 - Fire-Fighting Measures

Flash Point: Nonflammable
Autoignition Temperature: Not applicable
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Water spray or fog; foam, dry chemical powder, or BCF (where regulations permit).
Carbon dioxide.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Will not burn but increases intensity of fire.
Heating may cause expansion or decomposition leading to violent rupture of containers.
Heat affected containers remain hazardous.
Contact with combustibles such as wood, paper, oil or finely divided metal may cause ignition, combustion or violent decomposition.
May emit irritating, poisonous or corrosive fumes.
Decomposes on heating and produces toxic fumes of nitrogen oxides (NO_x) and nitric acid.

Fire Incompatibility: Oxidizing agents as a class are not necessarily combustible themselves, but can increase the risk and intensity of fire in many other substances.
Reacts vigorously with water and alkali.
Avoid reaction with organic materials/compounds, powdered metals, reducing agents and hydrogen sulfide (H_2S) as ignition may result.
Reacts with metals producing flammable/explosive hydrogen gas.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
Extinguishers should be used only by trained personnel.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.
If fire gets out of control withdraw personnel and warn against entry.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: Dangerous levels of nitrogen oxides may form during spills of nitric acid.
Wear fully protective PVC clothing and breathing apparatus.
Clean up all spills immediately. No smoking, bare lights, ignition sources.
Avoid all contact with any organic matter including fuel, solvents, sawdust, paper or cloth and other incompatible materials, as ignition may result.
Avoid breathing dust or vapors and all contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb spill with dry sand, earth, inert material or vermiculite. DO NOT use sawdust as fire may result.
Scoop up solid residues and seal in labeled drums for disposal.
Neutralize/decontaminate area.
Use soda ash or slaked lime to neutralize.

See DOT ERG

Large Spills: DO NOT touch the spill material. Restrict access to area.
Clear area of personnel and move upwind. Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, flames or ignition sources. Increase ventilation.
Contain spill with sand, earth or other clean, inert materials.
NEVER use organic absorbents such as sawdust, paper, cloth; as fire may result. Avoid any contamination by organic matter.
Use spark-free and explosion-proof equipment.
Collect any recoverable product into labeled containers for possible recycling. DO NOT mix fresh with recovered material.
Collect residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains. Decontaminate equipment and launder all protective clothing before storage and reuse.
If contamination of drains or waterways occurs advise emergency services.
DO NOT USE WATER OR NEUTRALIZING AGENTS INDISCRIMINATELY ON LARGE SPILLS.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid generating and breathing mist. Do not allow clothing wet with material to stay in contact with skin.
Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area.
WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
Avoid smoking, bare lights or ignition sources.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling. Work clothes should be laundered separately.
Launder contaminated clothing before reuse.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.

Recommended Storage Methods: Stainless steel drum. Check that containers are clearly labeled.
Packaging as recommended by manufacturer.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area.
Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Bare unprotected skin should not be exposed to this material. Impervious, gauntlet length gloves i.e., butyl rubber gloves or Neoprene rubber gloves or wear chemical protective gloves, e.g. PVC.

Wear safety footwear or safety gumboots, e.g. Rubber.

Respiratory Protection:

Exposure Range >2 to <25 ppm: Supplied Air, Constant Flow/Pressure Demand, Half Mask

Exposure Range 25 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face

Other: Operators should be trained in procedures for safe use of this material.

Acid-resistant overalls or Rubber apron or PVC apron.

Ensure there is ready access to an emergency shower.

Ensure that there is ready access to eye wash unit.

Ensure that there is ready access to breathing apparatus.

Glove Selection Index:

BUTYL ..... Best selection
HYPALON ..... Best selection
NEOPRENE..... Best selection
NEOPRENE/NATURAL..... Best selection
PE/EVAL/PE ..... Best selection
SARANEX-23 ..... Best selection
NATURAL RUBBER..... Satisfactory; may degrade after 4 hours continuous immersion
NATURAL+NEOPRENE..... Satisfactory; may degrade after 4 hours continuous immersion
PVC..... Poor to dangerous choice for other than short-term immersion
NITRILE+PVC..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to slightly yellow liquid. Sharp strong odor.
CAUTION: exothermic dilution hazard.
HIGHLY CORROSIVE. Corrosive to most metals. Powerful oxidizing agent.
Darkens to brownish color on aging and exposure to light.

Physical State: Liquid
Odor Threshold: 0.75 to 2.50 mg/m^3
Vapor Pressure (kPa): 8.26
Vapor Density (Air=1): 1.5
Formula Weight: 63.02
Specific Gravity (H_2O=1, at 4 °C): 1.3-1.42
pH: < 1

pH (1% Solution): 1
Boiling Point: 83 °C (181 °F) at 760 mm Hg
Freezing/Melting Point: -42 °C (-43.6 °F)
Volatile Component (% Vol): 100 (nominal)
Decomposition Temperature (°C): Not applicable
Water Solubility: Soluble in all proportions

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Presence of heat source and direct sunlight. Storage in unsealed containers. Hazardous polymerization will not occur.

Storage Incompatibilities: Segregate from reducing agents, finely divided combustible materials, combustible materials, sawdust, metals and powdered metals.

Avoid contamination of water, foodstuffs, feed or seed.

Segregate from alkalies, oxidizing agents and chemicals readily decomposed by acids, i.e. cyanides, sulfides, carbonates.

Section 11 - Toxicological Information

Toxicity

Oral (human) LD_{Lo}: 430 mg/kg
Inhalation (rat) LC_{50}: 2500 ppm/1 hr
Unreported (man) LD_{Lo}: 110 mg/kg

Irritation

Nil reported

See *RTECS* QU 5775000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.

Ecotoxicity: LC_{50} Starfish 100-300 mg/l/48 hr /Aerated water conditions; LC_{50} Shore crab 180 mg/l/48 hr /Static, aerated water conditions; LC_{50} Cockle 330-1000 mg/l/48 hr /Aerated water conditions

BCF: no food chain concentration potential

Biochemical Oxygen Demand (BOD): none

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Special hazards may exist - specialist advice may be required.
Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Treat and neutralize at an approved treatment plant.
Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.
Puncture containers to prevent reuse and bury at an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Nitric acid *other than red fuming, with more than 70 percent nitric acid*

ID: UN2031
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols:
Label Codes: 8 - Corrosive, 5.1 - Oxidizer
Special Provisions: B47, B53, T10, TP2, TP12, TP13
Packaging: **Exceptions:** None **Non-bulk:** 158 **Bulk:** 243
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 2.5 L
Vessel Stowage: **Location:** D **Other:** 44, 66, 89, 90, 110, 111

Shipping Name and Description: Nitric acid *other than red fuming, with not more than 70 percent nitric acid*

ID: UN2031
Hazard Class: 8 - Corrosive material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 8 - Corrosive
Special Provisions: B2, B47, B53, IB2, T8, TP2, TP12
Packaging: **Exceptions:** None **Non-bulk:** 158 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** 30 L
Vessel Stowage: **Location:** D **Other:**

Shipping Name and Description: Nitric acid, red fuming

ID: UN2032
Hazard Class: 8 - Corrosive material
Packing Group: I - Great Danger
Symbols: + - Override definitions
Label Codes: 8 - Corrosive, 5.1 - Oxidizer, 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: 2, B9, B32, B74, T20, TP2, TP12, TP13, TP38, TP45
Packaging: **Exceptions:** None **Non-bulk:** 227 **Bulk:** 244
Quantity Limitations: **Passenger aircraft/rail:** Forbidden **Cargo aircraft only:** Forbidden
Vessel Stowage: **Location:** D **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4) 1000 lb (453.5 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Listed
RQ: 1000 lb
TPQ: 1000 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Polychlorinated Biphenyls (PCBs)
POL2140

Issue Date: 2005-05

Section 1 - Chemical Product and Company Identification 54/60

Material Name: Polychlorinated Biphenyls (PCBs) **CAS Number:** 1336-36-3
Chemical Formula: Unspecified or Variable
Structural Chemical Formula: $(C_{12}H_{10-x})Cl_x$
EINECS Number: 215-648-1
ACX Number: X1004032-9
Synonyms: AROCLOR; AROCLOR 1221; AROCLOR 1232; AROCLOR 1242; AROCLOR 1248; AROCLOR 1254; AROCLOR 1260; AROCLOR 1262; AROCLOR 1268; AROCLOR 2565; AROCLOR 4465; AROCLOR 5442; 1,1'-BIPHENYL,CHLORO DERIVS; BIPHENYL,POLYCHLORO-; CHLOPHEN; CHLOREXTOL; CHLORINATED BIPHENYL; CHLORINATED DIPHENYL; CHLORINATED DIPHENYLENE; CHLORO 1,1-BIPHENYL; CHLORO 1,1-BIPHENYL-; CHLORO BIPHENYL; CLOPHEN; CLOPHEN A 60; DYKANOL; EPA PESTICIDE CHEMICAL CODE 017801; FENCLOR; FENCLOR 42; INERTEEN; KANECHLOR; KANECHLOR 300; KANECHLOR 400; MONTAR; MONTER; NOFLAMOL; PCB; PCBS; PHENOCHLOR; PHENOCLOR; POLYCHLORINATED BIPHENYL; POLYCHLORINATED BIPHENYLS; POLYCHLORINATED BIPHENYLS (PCBS); POLYCHLOROBIPHENYL; PYRALENE; PYRANOL; SANTOTHERM; SANTOTHERM FR; SOVOL; THERMINOL; THERMINOL FR-1
General Use: Used as dielectric fluids in transformers and capacitors. Prior to 1972, were used as hydraulic and other industrial fluids (e.g., in vacuum pumps, as lubricants and cutting oils), in paints, inks and fire retardants.
Also used in heat transfer systems; gas-transmission turbines; carbonless reproducing paper; adhesives; as plasticizer in epoxy paints; fluorescent light ballasts; wax extenders; coolants; dedusting agents; pesticide extenders; surface treatment and coatings; sealants; caulking material.
This is one of a group of once widely used industrial chemicals whose high stability contributed both to their commercial usefulness and the long term deleterious environmental health effects. Consequently their use has been phased out. Their manufacture in the U.S.A. was discontinued in 1977.

Section 2 - Composition / Information on Ingredients

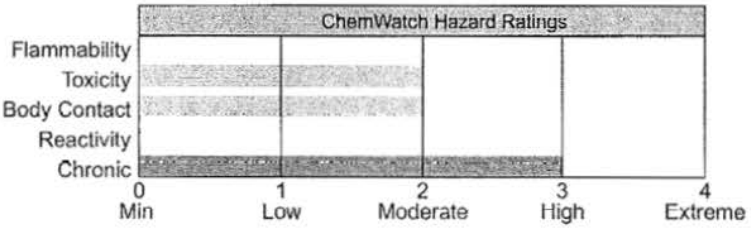
Name	CAS	%
polychlorinated biphenyls (PCB's)	1336-36-3	100

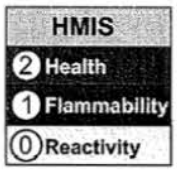
OSHA PEL **NIOSH REL**

ACGIH TLV

Section 3 - Hazards Identification

Fire Diamond





ANSI Signal Word

Warning!

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Oily liquid, white crystalline solid, or hard resin. Severely irritating. Suspect cancer hazard. Chronic Effects: chloracne, GI disturbances, neurological symptoms, liver enlargement, menstrual changes, bronchitis, possible reproductive/teratogenic effects.

Potential Health Effects

Target Organs: skin, liver, eyes, mucous membranes, respiratory system
Primary Entry Routes: inhalation, skin contact, ingestion

Acute Effects

Inhalation: Not normally a hazard due to nonvolatile nature of product. Inhalation of vapor is more likely at higher than normal temperatures.

The vapor/mist is discomforting and may be extremely toxic if inhaled.

Eye: The vapor/liquid is moderately discomforting and may be harmful to the eyes.

Skin: The liquid is harmful to the skin, it is rapidly absorbed and is capable of causing skin reactions.

Exposure to material may result in a dermatitis, described as chloracne, a persistent acneiform characterized by comedones (white-, and black- heads), keratin cysts, and inflammed papules with hyperpigmentation and an anatomical distribution frequently involving the skin under the eyes and behind the ears. It occurs after acute or chronic exposure to a variety of chlorinated aromatic compounds by skin contact, ingestion or inhalation and may appear within days and months following the first exposure. Other dermatological alterations including hypertrichosis (the growth of excess hair), an increased incidence of actinic or solar elastosis (the degeneration of elastic tissue within muscles or loss of dermal elasticity produced by the effects of sunlight), and Peyrone's disease (a rare progressive scarring of the penile membrane).

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.

The material is moderately discomforting to the gastrointestinal tract and may be harmful if swallowed in large quantity.

Ingestion may result in nausea, pain, vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Digestion may lead to nausea, vomiting, abdominal pain, anorexia, jaundice and liver damage, coma and death.

Headache, dizziness, lethargy, depression, nervousness, loss of libido, muscle, joint pains may be found.

Symptoms appear after a latent period of 5 to 6 months.

PCB's may appear in breast milk of exposed mothers and in newborn infants.

Carcinogenicity: NTP - Class 2B, Reasonably anticipated to be a carcinogen, sufficient evidence of carcinogenicity from studies in experimental animals; IARC - Group 2A, Probably carcinogenic to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class B2, Probable human carcinogen based on animal studies; MAK - Not listed.

Chronic Effects: People occupationally exposed to PCB's have relatively high PCB residue levels in blood plasma.

Symptoms include chloracne dermatitis and degreasing the skin, pigmentation of skin and nails, excessive eye discharge, swelling of eyelids, transient visual disturbances, distinctive hair follicles, edema of the face and hands.

In common with other polyhalogenated aromatic hydrocarbons, the chlorinated biphenyls exhibit dioxin-like behavior.

Polyhalogenated aromatic hydrocarbons (PHAHs) comprise two major groups.

The first group represented by the halogenated derivatives of dibenzodioxins (the chlorinated form is PCDD), dibenzofurans (PCDF) and biphenyls (PCB) exert their toxic effect (as hepatoxicants, reproductive toxicants, immunotoxicants and procarcinogens) by interaction with a cytostolic protein known as the Ah receptor. In guinea pigs the Ah receptor is active in a mechanism which "pumps" PHAH into the cell whilst in humans the reverse appears to true. This, in part, may account for species differences often cited in the literature. This receptor exhibits an affinity for the planar members of this group and carries these to the cellular nucleus where they bind, reversibly, to specific genomes on DNA.

This results in the regulation of the production of certain proteins which elicit the toxic response. The potency of the effect is dependent on the strength of the original interaction with the Ah receptor and is influenced by the degree of substitution by the halogen and the position of such substitutions on the parent compound.

The most potent molecule is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) while the coplanar PCBs (including mono-ortho coplanars) possess approximately 1% of this potency. Nevertheless, all are said to exhibit "dioxin-like" behavior and in environmental and health assessments it has been the practice to assign each a TCDD-equivalence value.

The most subtle and important biological effects of the PHAHs are the effects on endocrine hormones and vitamin homeostasis. TCDD mimics the effect of thyroxin (a key metamorphosis signal during maturation) and may disrupt patterns of embryonic development at critical stages. Individuals from exposed wildlife populations have been observed to have altered sexual development, sexual dysfunction as adults and immune system suppression.

Immunotoxic effects of the PHAHs (including the brominated congener, PBB) have been the subject of several studies. No clear pattern emerges in human studies however with T-cell numbers and function (a blood marker for immunological response) increasing in some and decreasing in others.

Three incidences have occurred which have introduced abnormally high levels of dioxin or dioxin-like congeners to humans. The explosion at a trichlorophenol-manufacturing plant in Seveso, Italy distributed TCDD across a large area of the country-side, whilst rice-oil contaminated with heat-transfer PCBs (and dioxin-like contaminants) has been consumed by two groups, on separate occasions (one in Yusho, Japan and another in Yu-cheng, Taiwan). The only symptom which can unequivocally be related to all these exposures is the development of chloracne, a disfiguring skin condition, following each incident. Contaminated oil poisonings also produced eye-discharge, swelling of eyelids and visual disturbances. The Babies born up to 3 years after maternal exposure (so-called "Yusho-babies") were characteristically brown skinned, colored gums and nails and (frequently) produced eye-discharges. Delays in intellectual development have been noted. It has been estimated that Yu-cheng patients consumed an average level of 0.06 mg/kg body weight/day total PCB and 0.0002 mg/kg/day of PCDF before the onset of symptoms after 3 months. When the oil was withdrawn after 6 months they had consumed 1 gm total PCB containing 3.8 mg PCDF.

Preliminary data from the Yusho cohort suggests a six-fold excess of liver cancer mortality in males and a three-fold excess in women.
Recent findings from Seveso indicate that the biological effects of low level exposure (BELLEs), experienced by a cohort located at a great distance from the plant, may be hormetic, i.e. may be protective AGAINST the development of cancer.
TCDD induces carcinogenic effects in the laboratory in all species, strains and sexes tested. These effects are dose-related and occur in many organs.
Exposures as low as 0.001 ug/kg body weight/day produce carcinoma.
Several studies implicate PCBs in the development of liver cancer in workers as well as multi-site cancers in animals.
The second major group of PHAH consists of the non-planar PCB congeners which possess two or more ortho-substituted halogens. These have been shown to produce neurotoxic effects which are thought to reduce the concentration of the brain neurotransmitter, dopamine, by inhibiting certain enzyme-mediated processes.
The specific effect elicited by both classes of PHAH seems to depend on the as much on the developmental status of the organism at the time of the exposure as on the level of exposure over a lifetime.

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids. Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

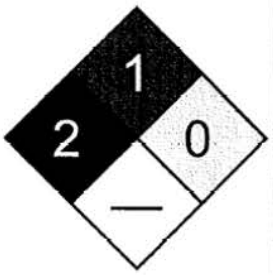
Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water). Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center. DO NOT induce vomiting. Observe the patient carefully. Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. Give water (or milk) to rinse out mouth. Then provide liquid slowly and as much as casualty can comfortably drink. Transport to hospital or doctor without delay.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Treat symptomatically. If large amounts are ingested, gastric lavage is suggested. For splash in the eyes, a petrolatum-based ophthalmic ointment may be applied to the eye to relieve the irritating effects of PCBs.
If electrical equipment arcs over, PCB dielectric fluids may decompose to produce hydrogen chloride (HCl), a respiratory irritant. [Monsanto] Preplacement and annual medical examinations of workers, with emphasis on liver function, skin condition, reproductive history, is recommended.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: > 141 °C
Autoignition Temperature: 240 °C
LEL: Not applicable
UEL: Not applicable
Extinguishing Media: Foam.Alcohol stable foam.
Dry chemical powder.
General Fire Hazards/Hazardous Combustion Products: Noncombustible liquid.
POLLUTANT -contain spillage.
Decomposes on heating and produces acrid black soot and toxic fumes of aldehydes, hydrogen chloride (HCl), chlorides and extremely toxic polychlorinated dibenzofuran (PCDF), polychlorinated dibenzodioxin (PCDD).
Fire Incompatibility: Reacts vigorously with chlorine (Cl2).
Fire-Fighting Instructions: POLLUTANT -contain spillage. Noncombustible.
Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Use fire fighting procedures suitable for surrounding area.
Cool fire-exposed containers with water spray from a protected location.
Avoid spraying water onto liquid pools.
If safe to do so, remove containers from path of fire.
Equipment should be thoroughly decontaminated after use.

Section 6 - Accidental Release Measures

Small Spills: POLLUTANT -contain spillage. Clean up all spills immediately.
Environmental hazard - contain spillage.
Avoid breathing vapors and contact with skin and eyes.
Wear protective clothing, impervious gloves and safety glasses.
Contain spill with sand, earth or vermiculite.
Wipe up and absorb small quantities with vermiculite or other absorbent material.
Place spilled material in clean, dry, sealable, labeled container.

Large Spills: POLLUTANT -contain spillage. Clear area of personnel.
Contact fire department and tell them location and nature of hazard.
Wear full body protective clothing with breathing apparatus. Prevent, by any means available, spillage from entering drains or waterways.
Stop leak if safe to do so.
Contain spill with sand, earth or vermiculite.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect residues and seal in labeled drums for disposal.
After clean-up operations, decontaminate and launder all protective clothing and equipment before storing and reusing.
If equipment is grossly contaminated, decontaminate and destroy.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Do not allow clothing wet with material to stay in contact with skin Use good occupational work practices. Observe manufacturer's storing and handling recommendations.
Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Avoid all personal contact, including inhalation.
Wear protective clothing and gloves when handling containers.
Avoid physical damage to containers.
Use in a well-ventilated area and Use only in completely enclosed system.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Wash hands with soap and water after handling.
Work clothes should be laundered separately: NOT at home.
Recommended Storage Methods: Packaging as recommended by manufacturer.
Check that containers are clearly labeled.
Metal can or metal drum or Steel drum with plastic liner.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Provide adequate ventilation in warehouse or closed storage areas.
If inhalation risk of overexposure exists, wear NIOSH-approved organic-vapor respirator.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; chemical goggles.
Full face shield.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Impervious gloves or Viton gloves or Polyethylene gloves or PVC gloves.
Protective footwear.
Other: Impervious protective clothing. Overalls. Impervious apron.
Eyewash unit.
Ensure there is ready access to a safety shower.

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear, colorless to yellow-green, mobile oily to viscous liquid, or sticky to hard resin, or white crystalline solid, depending on degree of chlorination. Slightly soluble in glycerol and glycols. Soluble in organic solvents and lipids. Viscosity range: 71 - 2500 Saybolt unit sec. at 38 °C. PCBs are resistant to chemical and biological degradation and because of their solubility in fats and oils they tend to be concentrated in living organisms. The highly chlorinated PCBs are retained in animal's bodies longer and seems to delay the excretion of the lower chlorinated PCB's. They have become widely dispersed in the world-wide environment and in the food-chain since their introduction in 1929. They are now recognized internationally to be a major environmental pollutant, their persistence causing ecological damage via water pollution. Consequently loss of PCBs to the environment is to be avoided at all costs.

Physical State: Liquid
Vapor Pressure (kPa): Negligible
Formula Weight: 188.66 - 395
Specific Gravity (H_2O=1, at 4 °C): 1.18 - 1.8
Evaporation Rate: Non Vol. at 38 °C
pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 340 °C (644 °F) to 375 °C (707 °F)
Decomposition Temperature (°C): 375-550
Water Solubility: Solubility in water extremely low

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers. Segregate from chlorine.
Avoid contamination of water, foodstuffs, feed or seed.

Section 11 - Toxicological Information

Toxicity
Oral (human) LD_{Lo}: 500 mg/kg
Oral (rat) LD_{50}: 3980 mg/kg

Irritation
Nil reported

See *RTECS* TQ1350000, for additional data.

Section 12 - Ecological Information

Environmental Fate: PCBs are mixtures of different congeners of chlorobiphenyl and the relative importance of the environmental fate mechanisms generally depends on the degree of chlorination. In general, the persistence of PCBs increases with an increase in the degree of chlorination. Mono-, di- and trichlorinated biphenyls (Aroclor 1221 and 1232) biodegrade relatively rapidly, tetrachlorinated biphenyls (Aroclors 1016 and 1242) biodegrade slowly, and higher chlorinated biphenyls (Aroclors 1248, 1254, and 1260) are resistant to biodegradation. Although biodegradation of higher chlorinated congeners may occur very slowly on an environmental basis, no other degradation mechanisms have been shown to be important in natural water and soil systems; therefore, biodegradation may be the ultimate degradation process in water and soil.

If released to soil, PCBs experience tight adsorption with adsorption generally increasing with the degree of chlorination. PCBs will generally not leach significantly in aqueous soil systems; the higher chlorinated congeners will have a lower tendency to leach than the lower chlorinated congeners. In the presence of organic solvents PCBs may leach quite rapidly through soil. Vapor loss from soil surfaces appears to be an important fate mechanism with the rate of volatilization decreasing with increasing chlorination. Although the volatilization rate may be low, the total loss by volatilization over time may be significant because of persistence and stability. Enrichment of the low Cl PCBs occurs in the vapor phase relative to the original Aroclor; the residue will be enriched in the PCBs containing high Cl content.

If released to water, adsorption to sediment and suspended matter will be an important fate process; PCB concentrations in sediment and suspended matter have been shown to be greater than in the associated water column. Although adsorption can immobilize PCBs (especially the higher chlorinated congeners) for relatively long periods of time, eventual resolution into the water column has been shown to occur. The PCB composition in the water will be enriched in the lower chlorinated PCBs because of their greater water solubility, and the least water soluble PCBs (highest Cl content) will remain adsorbed. In the absence of adsorption, PCBs volatilize relatively rapidly from water. However, strong PCB adsorption to sediment significantly competes with volatilization, with the higher chlorinated PCBs having longer half-lives than the lower chlorinated PCBs. Although the resulting volatilization rate may be low, the total loss by volatilization over time may be significant because of persistence and stability. PCBs have been shown to bioconcentrate significantly in aquatic organisms. If released to the atmosphere, PCBs will primarily exist in the vapor-phase; the tendency to become associated with the particulate-phase will increase as the degree of chlorination of the PCB increases. The dominant atmospheric transformation process is probably the vapor-phase reaction with hydroxyl radicals which has estimated half-lives ranging from 12.9 days for monochlorobiphenyl to 1.31 years for heptachlorobiphenyl. Physical removal from the atmosphere, which is very important environmentally, is accomplished by wet and dry deposition.

Ecotoxicity: Aquatic toxicity: 0.278 ppm/96 hr/bluegill/TL_m/fresh water 0.005 ppm/336-1080 hr/pinfish/TL_m/salt water; Waterfowl toxicity: LD_{50} 2000 ppm (mallard duck); Food chain concentration potential: High
Henry's Law Constant: 5×10^{-5}
BCF: bioconcentrate in tissue
Biochemical Oxygen Demand (BOD): very low
Soil Sorption Partition Coefficient: $K_{oc} = 510$ to 1.33×10^{4}

Section 13 - Disposal Considerations

Disposal: Recycle wherever possible. Consult manufacturer for recycling options.
Follow applicable federal, state, and local regulations.
Due to their environmental persistence and potential health hazards, PCBs cannot be disposed of in landfills or dumped at sea. The only environmentally acceptable method for the disposal of PCBs is by high temperature incineration.
All wastes and residues containing PCB's (e. g. , wiping cloths, absorbent material, used disposable protective gloves, contaminated clothing, etc.) should be collected, placed in proper containers, labelled and disposed of in accordance with applicable regulations.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Polychlorinated biphenyls, liquid
ID: UN2315
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 9 - Class 9
Special Provisions: 9, 81, 140, IB3, T4, TP1
Packaging: **Exceptions:** 155 **Non-bulk:** 202 **Bulk:** 241
Quantity Limitations: **Passenger aircraft/rail:** 100 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:** 95

Shipping Name and Description: Polychlorinated biphenyls, solid
ID: UN2315
Hazard Class: 9 - Miscellaneous hazardous material
Packing Group: II - Medium Danger
Symbols:
Label Codes: 9 - Class 9
Special Provisions: 9, 81, 140, IB7
Packaging: **Exceptions:** 155 **Non-bulk:** 212 **Bulk:** 240
Quantity Limitations: **Passenger aircraft/rail:** 100 kg **Cargo aircraft only:** 200 kg
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:
RCRA 40 CFR: Not listed
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per CWA Section 307(a) 1 lb (0.454 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Potassium Cyanide
POT3380

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Potassium Cyanide
CAS Number: 151-50-8
Chemical Formula: CKN
Structural Chemical Formula: KCN
EINECS Number: 205-792-3
ACX Number: X1000070-3
Synonyms: M-44 CAPSULES (POTASSIUM CYANIDE); CYANIDE OF POTASSIUM; CYANURE DE POTASSIUM; EPA PESTICIDE CHEMICAL CODE 599600; HYDROCYANIC ACID,POTASSIUM SALT; KALIUM CYANID; POTASSIUM CYANIDE; POTASSIUM SALT OF HYDROCYANIC ACID
Derivation: By absorption of hydrogen cyanide in potassium hydroxide.
General Use: In the extraction of gold and silver from ores; metal cleaning; heat treatment of metals; electroplating; as a reagent in analytical chemistry; raw material in the manufacture of dyes, pigments, nylon, and chelating agents; an insecticide; and a fumigant.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Potassium Cyanide		ca 95 % wt (commercial); other grades include pure, solution, and reagent. Trace Impurities: potassium carbonate, formate, and hydroxide.

OSHA PEL
TWA: 5 mg/m^3; skin, as CN.

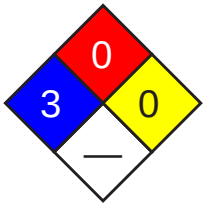
ACGIH TLV
Ceiling: 5 mg/m^3; skin.

NIOSH REL
Ceiling: 5 mg/m^3 (4.7 ppm) (10-minute).

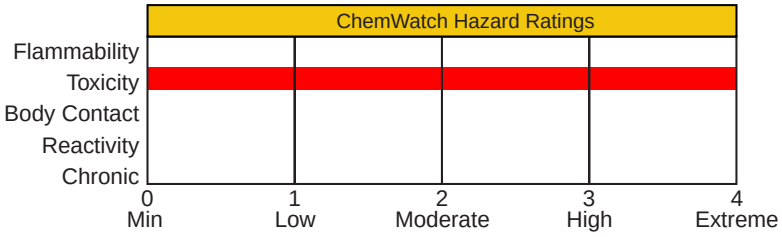
IDLH Level
25 mg/m^3 (as CN).

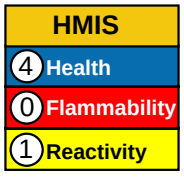
DFG (Germany) MAK
TWA: 5 mg/m^3; PEAK: 5 mg/m^3; skin; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word

Danger!


Poison Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, amorphous, deliquescent lumps or a crystalline mass; faint odor of bitter almonds. Corrosive to eyes/skin. Poison. Reacts with water.

Potential Health Effects

Target Organs: Eyes; skin; upper respiratory, cardiovascular, and central nervous systems; thyroid; blood.
Primary Entry Routes: Inhalation; skin absorption; skin and/or eye contact; ingestion.
Acute Effects

Inhalation: Irritation of the nose and throat and systemic symptoms like those seen via ingestion may also be caused by absorption through the mucous membranes. Nose irritation leading to obstruction, bleeding, sloughs, and in some cases septum perforation has been reported in workers in the electroplating industry.

Eye: Irritation and possible burns. Dilated pupils are common in severe poisoning. Corneal edema (swelling) may occur. Human poisoning cases due to eye exposure only have not been reported.

Skin: Itching, irritation, discoloration (bright pink color), dermatitis, rash, or corrosion (burns) may occur. Systemic symptoms like those seen via ingestion may also be caused by skin absorption. Mild systemic symptoms such as headache and dizziness have been caused by solutions as dilute as 0.5% potassium cyanide.

Ingestion: Chemical asphyxia and death may occur without warning from severe exposure. Initial symptoms of lesser exposure include burning, acrid, bitter taste upon ingestion, weakness, headache, flushing, dizziness, confusion, salivation, nausea and vomiting, hyperventilation, bradycardia (slowed heart beat), hypertension (high blood pressure), and anxiety. These may progress to increased rate and depth of respiration, slow and gasping respiration, pulmonary edema (fluid in lungs), lactic acidosis (abnormal accumulation of lactic acid in the blood resulting in a metabolic derangement), stupor, seizures, coma, apnea (absence of breathing), tachycardia (rapid heart beat), hypotension (low blood pressure), and death.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Disorders of the skin, thyroid, and cardiovascular, upper respiratory, and central nervous systems.

Chronic Effects: Dermatitis, scarlet rash and papules, and itching have been reported in workers in the electroplating industry. Other symptoms may include headache, weakness, nausea, dizziness, loss of appetite, insomnia, memory loss, tremors, functional changes in hearing, enlarged thyroid gland, folate abnormalities, palpitations, chest discomfort, upper respiratory tract irritation, nose bleeds, and eye irritation.

Section 4 - First Aid Measures

See DOT ERG

Inhalation: *Note!* The odor of bitter almonds may be noted on the breath or vomitus. Remove exposed person to fresh air and immediately begin therapy with 100% oxygen.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist immediately if irritation or pain develop.

Skin Contact: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash exposed area extremely thoroughly with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, *do not* induce vomiting.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Determine hemoglobin, arterial blood gases, venous pO_2 or measured versus $\%O_2$ saturation, serum lactate, electrolytes, and whole blood cyanide levels. If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. For cases of ingestion, perform gastric lavage with a large bore tube after endotracheal intubation.

Special Precautions/Procedures: To prevent self-poisoning, avoid mouth-to-mouth resuscitation during CPR. To avoid becoming secondary victims, do not enter areas with high potential airborne concentrations without donning a self-contained breathing apparatus (SCBA). Give specific and detailed instructions on the use of cyanide antidote kits to all persons working with and around potassium cyanide.

Section 5 - Fire-Fighting Measures

See DOT ERG

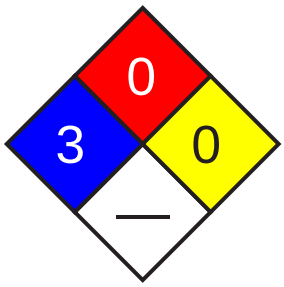
Flash Point: Noncombustible

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use extinguishing media suitable for surrounding fire. Do not use carbon dioxide extinguisher; this can liberate hydrogen cyanide by the action of the dissolved carbon dioxide. Water may be used on surrounding fires *not* involving potassium cyanide. Use alkali dry chemical. Keep fire-exposed containers cool with water spray.



Fire Diamond

General Fire Hazards/Hazardous Combustion Products: Nitrogen oxides and cyanide. Potassium cyanide reacts with water or any acid-releasing flammable hydrogen cyanide.

Fire-Fighting Instructions: Do not release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighter's protective clothing is *not* effective for potassium cyanide.

Section 6 - Accidental Release Measures

See DOT ERG

Spill/Leak Procedures: Notify safety personnel immediately, evacuate all unnecessary personnel, and isolate and ventilate area. Cleanup personnel should wear fully-encapsulating protective clothing to protect against inhalation, skin and eye contact.

Small Spills: Carefully scoop up the spilled potassium cyanide and place in dry containers for disposal or reclamation. For potassium cyanide solution spills, take up with a noncombustible, absorbent material such as sand or vermiculite and place in containers for later disposal. Neutralize with a strong alkali solution of calcium hypochlorite.

Large Spills: For large dry spills, cover with a plastic sheet to avoid dust dispersion until later disposal. For large solution spills, dike far ahead for later disposal. Do not release into sewers or waterways. Prompt cleanup and removal are necessary. To avoid generating dust, *do not* sweep! Remove residue by vacuuming (with an appropriate HEPA filter) or mopping with a liberal quantity of water.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all contact with potassium cyanide. Use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Wear appropriate personal protective equipment to protect against skin and eye contact. Make cyanide antidote kits readily available in all areas where potassium cyanide is used. Replace ingredients of kits every 1-2 yr to ensure freshness. Practice good personal hygiene procedures to avoid inadvertently ingesting potassium cyanide.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using potassium cyanide, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, dry, well-ventilated area away from light, acids, water, carbon dioxide, and other incompatibles (Sec. 10). Outside or detached storage is preferred. Protect from physical damage. Keep containers covered or in an exhausted hood when not in use.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose all operations to avoid dust dispersion into the workplace. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the cardiovascular, upper respiratory, and nervous systems, skin, and thyroid. Maintain pertinent medical records for 5 years following the last exposure. Educate workers about the hazards of potassium cyanide and train in emergency first aid procedures for cyanide poisoning.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. Polyvinyl chloride, Neoprene, butyl rubber, fluoronitrile carbon rubber, nitrile rubber, and chlorinated polyethylene are recommended materials for PPE. Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations <= 25 mg/m^3, wear a supplied-air respirator or any SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure- demand or other positive-pressure mode. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove potassium cyanide from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White lumps or colorless crystals; faint odor of bitter almonds.

Physical State: Solid

Vapor Pressure (kPa): ~0 mm Hg at 68 °F (20 °C)

Formula Weight: 65.11

Specific Gravity (H_2O=1, at 4 °C): 1.55

Refractive Index: 1.410

pH: (0.1N aqueous solution) 11.0

Boiling Point: 2957 °F (1625 °C)

Freezing/Melting Point: 1173 °F (634 °C)

Water Solubility: Soluble

Other Solubilities: Soluble in 100 parts alcohol, soluble in 25 parts methanol, and soluble in 2 parts glycerol.

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Potassium cyanide is stable at room temperature in closed containers under normal storage and handling conditions. It absorbs moisture and carbon dioxide from the air and slowly decomposes. Hazardous polymerization cannot occur. Avoid contact with acids, water, and other incompatibles.

Storage Incompatibilities: Potassium cyanide is incompatible with acids (releases highly toxic hydrogen cyanide gas), metallic salts, permanganates, peroxides, perchloryl fluoride, chlorates (potassium cyanide and sodium chlorate explode when heated), nitrites, oxidizing agents, nitrogen trichloride, iodine, alkaloids, ammoniacal silver, mercury (II) nitrate, and chromium tetraoxide. Hydrogen cyanide gas is also released when sodium cyanide is dissolved in and reacts with water. However, unless this occurs in a closed space, the amount is too small to be hazardous. Potassium cyanide also reacts with carbon dioxide in the air to release hydrogen cyanide gas.

Hazardous Decomposition Products: Thermal oxidative decomposition of potassium cyanide can produce nitrogen oxides and cyanide gas.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 5 mg/kg.

Man, oral, TD_{Lo}: 13699 µg/kg caused convulsions or effect on seizure threshold, coma, and metabolic acidosis.

Woman, oral, TD_{Lo}: 100 mg/kg caused convulsions or effect on seizure threshold, increased pulse rate without fall in blood pressure, and blood pressure lowering not characterized in autonomic section.

Human, oral, LD_{Lo}: 2857 µg/kg.

Other Effects:

Rat, oral: 31500 mg/kg/50 weeks/continuous caused changes in urine composition and thyroid weight and weight loss or decreased weight gain.

Rat, oral: 65 g/kg administered to a female 14 days prior to mating and during the 1-22 day of pregnancy caused toxic effects on fertility.

Mouse, lymphocyte: 1 mmol/L caused DNA inhibition.

See *RTECS* TS8750000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Potassium cyanide will readily dissociate in water and may then form hydrogen cyanide or react with various metals present in natural water. Complex metallocyanides may form if the cyanide ion is present in excess, but if metals are prevalent, simple metal cyanides may form. Bioconcentration: 0.3 (calculated from water solubility by regression equations). 3.0 (calculated from water solubility by regression equations).

Ecotoxicity: TL_m (fresh water Bluegill): 0.16 ppm for 48 hr; TL_m (salt water adult Zebrafish): 0.49 ppm for 48 hr

Section 13 - Disposal Considerations

Disposal: Add potassium cyanide with stirring to a strong alkaline solution of calcium hypochlorite. Let stand 24 hr and route to sewage plant (only with approval from local municipality). Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may still remain.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Potassium cyanide
ID: UN1680
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: B69, B77, IB7, IP1, N74, N75, T14, TP2, TP13
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** B **Other:** 52

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed P098
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 10 lb (4.535 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Listed
RQ: 10 lb
TPQ: 100 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
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Sodium Cyanide
SOD3100

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Sodium Cyanide **CAS Number:** 143-33-9
Chemical Formula: CNNa
Structural Chemical Formula: NaCN
EINECS Number: 205-599-4
ACX Number: X1000111-9
Synonyms: CIANURO DI SODIO; M-44 CYANIDE CAPSULES; CYANIDE OF SODIUM; CYANOBRIK; CYANOGRAN; CYANURE DE SODIUM; CYMAG; EPA PESTICIDE CHEMICAL CODE 074002; HYDROCYANIC ACID,SODIUM SALT; KYANID SODNY; SODIUM CYANIDE; SODIUM SALT OF HYDROCYANIC ACID
Derivation: By absorption of hydrogen cyanide in a solution of sodium hydroxide with subsequent vacuum evaporation; by heating sodium amide with carbon; or by melting sodium chloride and calcium cyanamide together in an electric furnace.
General Use: In the heat treatment of metals (case-hardening), the extraction of gold and silver from ores, electroplating operations (coppering, zincing), the manufacture of dyes, pigments, hydrogen cyanide, hydrocyanic acid, and mirrors; cleaning metals; insecticides; formerly for fumigation of citrus and other fruit trees, railway cars, ships, and warehouses; nylon intermediates; for ore flotation; and as a chelating compound.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
Sodium Cyanide	143-33-9	95-98% wt

Mixtures of sodium cyanide with sodium chloride or carbonate for special uses are also marketed, as well as other grades, including 30% solution; 73-75%; 96-98%; reagent; technical; and granular briquettes.

OSHA PEL
TWA: 5 mg/m^3; skin, as CN.

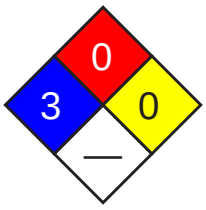
ACGIH TLV
Ceiling: 5 mg/m^3; skin.

NIOSH REL
Ceiling: 5 mg/m^3 (4.7 ppm) (10-minute).

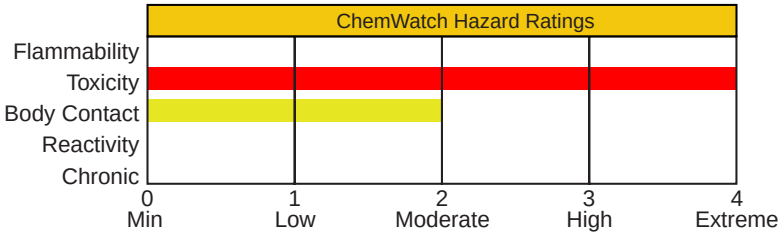
IDLH Level
25 mg/m^3 (as CN).

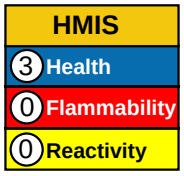
DFG (Germany) MAK
TWA: 3.8 mg/m^3; PEAK: 3.8 mg/m^3; skin; measured as inhalable fraction of the aerosol.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Poison Corrosive

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

White, granular or crystalline solid; faint, almond-like odor, odorless when dry. Corrosive to eyes/skin; irritating to respiratory tract. Poison. Produces hydrogen cyanide gas upon contact with acid/water.

Potential Health Effects

Target Organs: Eyes; skin; upper respiratory, cardiovascular, and central nervous systems; thyroid; blood.
Primary Entry Routes: Inhalation; skin absorption; skin and/or eye contact; ingestion.
Acute Effects
Inhalation: Irritation of the nose and throat. Systemic symptoms like those seen via ingestion may also be caused by absorption through the mucous membranes. Nose irritation leading to obstruction, bleeding, sloughs, and in some cases septum perforation has been reported in workers in the electroplating industry.

Eye: Irritation and possible burns. Dilated pupils are common in severe poisoning. Corneal edema (swelling) may occur. Human poisoning cases due to eye exposure only have not been reported.

Skin: Itching, irritation, discoloration (bright pink color), dermatitis, rash, or corrosion (burns) may occur. Systemic symptoms like those seen via ingestion may also be caused by skin absorption. Mild systemic symptoms such as headache and dizziness have been caused by solutions as dilute as 0.5% sodium cyanide.

Ingestion: Chemical asphyxia and death may occur without warning from severe exposure. Initial symptoms of lesser exposure include burning, acrid, bitter taste upon ingestion, weakness, headache, flushing, dizziness, confusion, salivation, nausea and vomiting, hyperventilation, bradycardia (slowed heart beat), hypertension (high blood pressure), and anxiety. These may progress to increased rate and depth of respiration, slow and gasping respiration, pulmonary edema (fluid in lungs), lactic acidosis (abnormal accumulation of lactic acid in blood resulting in a metabolic derangement), stupor, seizures, coma, apnea (absence of breathing), tachycardia (rapid heart beat), hypotension (low blood pressure), and death.

Carcinogenicity: NTP - Not listed; IARC - Not listed; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Not listed; MAK - Not listed.

Medical Conditions Aggravated by Long-Term Exposure: Disorders of the skin, thyroid, and cardiovascular, upper respiratory, and central nervous systems.

Chronic Effects: Dermatitis, scarlet rash and papules, and itching have been reported in workers in the electroplating industry. Other symptoms may include headache, weakness, nausea, dizziness, loss of appetite, insomnia, memory loss, tremors, functional changes in hearing, enlarged thyroid gland, folate abnormalities, palpitations, chest discomfort, upper respiratory tract irritation, nose bleeds, and eye irritation.

Section 4 - First Aid Measures

Inhalation: *Note!* The odor of bitter almonds may be noted on the breath or vomitus. Remove exposed person to fresh air and immediately begin therapy with 100% oxygen.

Eye Contact: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water for at least 15 min. Consult a physician or ophthalmologist immediately if irritation or pain develop.

Skin Contact: *Quickly* remove contaminated clothing. Speed is extremely important. Rinse with flooding amounts of water for at least 15 min. Wash exposed area extremely thoroughly with soap and water. For reddened or blistered skin, consult a physician.

Ingestion: Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center. Unless the poison control center advises otherwise, *do not* induce vomiting.

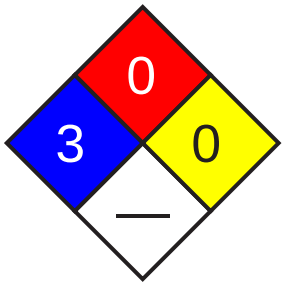
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Determine hemoglobin, arterial blood gases, venous pO_2 or measured versus $\%O_2$ saturation, serum lactate, electrolytes, and whole blood cyanide levels. If the victim is unconscious, bradycardia and absence of cyanosis may be key diagnostic signs. For cases of ingestion, perform gastric lavage with a large bore tube after endotracheal intubation.

Special Precautions/Procedures: Note! *In all cases of exposure where absorption may occur (i.e. inhalation, skin contact, and ingestion), administer 100% oxygen immediately and obtain and prepare the cyanide antidote kit for use in symptomatic patients.*

To prevent self-poisoning, avoid mouth-to-mouth resuscitation during CPR. To avoid becoming a secondary victim, *do not* enter areas with high potent ial airborne concentrations without donning a self-contained breathing apparatus (SCBA). Give specific and detailed instructions on the use of cyanide antidote kits to all persons working with an d around sodium cyanide.

Section 5 - Fire-Fighting Measures



Fire Diamond

Flash Point: Noncombustible

Autoignition Temperature: None reported.

LEL: None reported.

UEL: None reported.

Extinguishing Media: Use extinguishing media suitable for the surrounding fire. Do not use water directly on spilled sodium cyanide. *Do not* use carbon dioxide extinguishers; this can liberate hydrogen cyanide by the action of the dissolved carbon dioxide.

General Fire Hazards/Hazardous Combustion Products: Nitrogen and sodium oxides and cyanide. Containers may explode violently in the heat of fire. Material may be transported in a molten form.

Fire-Fighting Instructions: If feasible and without undue risk, move containers from fire hazard area. *Do not* release runoff from fire control methods to sewers or waterways. Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing is *not* effective for sodium cyanide. Remove and isolate contaminated clothing at the site.

Section 6 - Accidental Release Measures

Spill/Leak Procedures: Notify safety personnel immediately, evacuate all unnecessary personnel, and isolate and ventilate area. Cleanup personnel should wear fully-encapsulating protective clothing to protect against inhalation and skin and eye contact.

See DOT ERG

Small Spills: Neutralize with a strong alkali solution of calcium hypochlorite. Carefully scoop up the spilled sodium cyanide and place in dry containers for disposal or reclamation. For sodium cyanide solution spills, take up with a noncombustible, absorbent material such as sand or vermiculite and place in containers for later disposal.

Large Spills: For large spills, dike far ahead of liquid spill for later disposal. *Do not* release into sewers or waterways. Prompt cleanup and removal are necessary. To avoid generating dust, *do not* sweep! Remove residue by vacuuming (with an appropriate HEPA filter) or flushing with a liberal quantity of water.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all contact with sodium cyanide. Use only with ventilation sufficient to reduce airborne concentrations to nonhazardous levels. Wear appropriate personal protective equipment to protect against skin and eye contact. Make cyanide antidote kits readily available in all areas where sodium cyanide is used. Replace ingredients of kits every 1-2 yr to ensure freshness. Practice good personal hygiene procedures to avoid inadvertently ingesting sodium cyanide.

Never eat, drink, or smoke in work areas. Practice good personal hygiene after using sodium cyanide, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Recommended Storage Methods: Store in tightly closed containers in a cool, well-ventilated area away from water, acids, carbon dioxide, oxidizers, and other incompatibles (Sec. 10). Protect from physical damage. Keep containers covered or in exhausted hood when not in use.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Where feasible, enclose all operations to avoid dust dispersion into the workplace. Provide general or local exhaust ventilation systems to maintain airborne concentrations as low as possible. Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.

Administrative Controls: Consider preplacement and periodic medical exams with emphasis on the cardiovascular, upper respiratory, and nervous systems, skin, and thyroid. Maintain pertinent medical records for 5 years following the last exposure. Educate workers about the hazards of sodium cyanide and train in emergency first aid procedures for cyanide poisoning.

Personal Protective Clothing/Equipment: Wear chemically protective gloves, boots, aprons, and gauntlets to prevent skin contact. With breakthrough times of > 8 hr, natural rubber, Neoprene, nitrile rubber, and polyvinyl chloride are recommended materials for PPE for sodium cyanide (solid). Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.

Respiratory Protection: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For concentrations <= 25 mg/m^3, wear a supplied-air respirator or any SCBA with a full facepiece. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear any SCBA that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode or any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in pressure- demand or other positive-pressure mode. If respirators are used, OSHA requires a written respiratory protection program.

Other: Separate contaminated work clothes from street clothes. Launder before reuse. Remove sodium cyanide from your shoes and clean personal protective equipment. Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.

Section 9 - Physical and Chemical Properties

Appearance/General Info: White, deliquescent, powder, granular, egg-shaped, or flake form. It is odorless when dry, but may have the characteristic cyanide almond odor when wet.

Physical State: Solid

Vapor Pressure (kPa): ~0 mm Hg at 68 °F (20 °C); 1 mm Hg at 1503 °F (817 °C); 0.76 mm Hg at 1472 °F (800 °C)

Formula Weight: 49.01

Specific Gravity (H_2O=1, at 4 °C): 1.60 at 77 °F (25 °C) (solid)

Refractive Index: 1.452

pH: Aqueous solutions are strongly alkaline.

Boiling Point: 2725 °F (1496 °C)

Freezing/Melting Point: 1047 °F (563 °C)

Viscosity: 26% aqueous solution: 4 cP at 86 °F (30 °C) **Other Solubilities:** Slightly soluble in alcohol.
Water Solubility: Soluble

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Sodium cyanide is stable at room temperature in closed containers under normal storage and handling conditions. A solution of sodium cyanide in water slowly decomposes to release ammonia. Hazardous polymerization cannot occur. Avoid contact with acids and acid fumes and other incompatibles.

Storage Incompatibilities: Violent reactions occur with fluorine, magnesium, nitrates, nitric acid, and nitrites. It explodes when melted with nitrite or chlorate at about 842 °F (450 °C). Sodium cyanide reacts with acids (even weak) or acid fumes to release highly toxic hydrogen cyanide gas and sodium oxide. Hydrogen cyanide gas is also released when sodium cyanide is dissolved in and reacts with water. However, unless this occurs in a closed space, the amount is too small to be hazardous. Sodium cyanide also reacts with carbon dioxide in the air to release hydrogen cyanide gas. It is corrosive to aluminum.

Hazardous Decomposition Products: Thermal oxidative decomposition of sodium cyanide can produce nitrogen and sodium oxides and cyanide.

Section 11 - Toxicological Information

Acute Oral Effects:

Rat, oral, LD_{50}: 6440 µg/kg.
Man, TD_{Lo}: 714 µg/kg caused hallucinations, distorted perceptions, and muscle weakness.
Human, LD_{Lo}: 2857 µg/kg.

Other Effects:

Hamster, implant: 5999 mg/kg administered to a female during 6-9 days of pregnancy caused fetotoxicity and specific developmental abnormalities of the musculoskeletal and cardiovascular systems.
D. melanogaster: 200 ppb inhaled caused sex chromosome loss/nondisjunction.

See *RTECS* VZ7525000, for additional data.

Section 12 - Ecological Information

Environmental Fate: No data found.
Ecotoxicity: Fathead minnows, TL_m, 96 hr: 0.23 ppm. Bluegill, TL_m, 96 hr: 0.15 ppm. Trout, lethal, 1 hr: 2 ppm.

Section 13 - Disposal Considerations

Disposal: Add sodium cyanide with stirring to a strong alkaline solution of calcium hypochlorite. Let stand 24 hr and route to sewage plant (only with approval from local municipality). Sodium cyanide is a poor candidate for incineration. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations. Handle empty containers carefully as hazardous residues may remain.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Sodium cyanide
ID: UN1689
Hazard Class: 6.1 - Poisonous materials
Packing Group: I - Great Danger
Symbols:
Label Codes: 6.1 - Poison *or* Poison Inhalation Hazard *if inhalation hazard, Zone A or B*
Special Provisions: B69, B77, IB7, IP1, N74, N75, T14, TP2, TP13
Packaging: **Exceptions:** None **Non-bulk:** 211 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 kg **Cargo aircraft only:** 50 kg
Vessel Stowage: **Location:** B **Other:** 52

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed P106
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 10 lb (4.535 kg)
SARA 40 CFR 372.65: Not listed
SARA EHS 40 CFR 355: Listed
RQ: 10 lb
TPQ: 100 lb
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Toluene
CAS Number: 108-88-3
Chemical Formula: C_7H_8
Structural Chemical Formula: $C_6H_5CH_3$
EINECS Number: 203-625-9
ACX Number: X1001512-0
Synonyms: ANTISAL 1A; BENZENE,METHYL-; CP 25; METHACIDE; METHANE,PHENYL-; METHYL BENZENE; METHYL BENZOL; METHYLBENZENE; METHYLBENZOL; PHENYL METHANE; PHENYLMETHANE; TOLUEEN; TOLUEN; TOLUENE; TOLUENO; TOLUOL; TOLUOLO; TOLU-SOL
General Use: Used as a solvent for paint, resins, lacquers inks & adhesives. Component of solvent blends and thinners; in gasoline and aviation fuel. Used in the manufacture of chemicals, dyes, explosives, benzoic acid.
Some grades of toluene may contain traces of xylene and benzene.
Odor threshold: 2 ppm approx. Odor is not a reliable warning property due to olfactory fatigue.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
toluene	108-88-3	> 99.5

OSHA PEL
TWA: 200 ppm; Ceiling: 300 ppm; 500 ppm, 10-minute maximum peak.

ACGIH TLV
TWA: 50 ppm; skin.

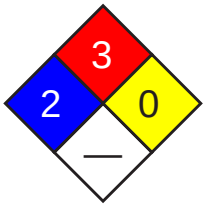
EU OEL
TWA: 192 mg/m^3 (50 ppm); STEL: 384 mg/m^3 (100 ppm).

NIOSH REL
TWA: 100 ppm (375 mg/m^3); STEL: 150 ppm (560 mg/m^3).

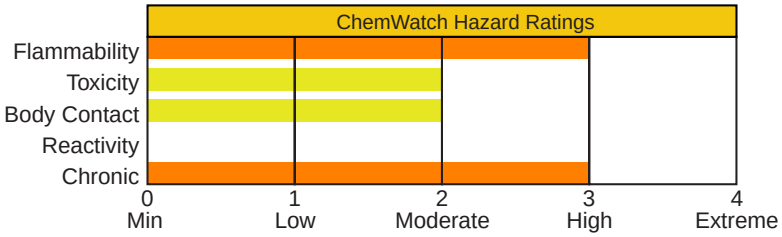
IDLH Level
500 ppm.

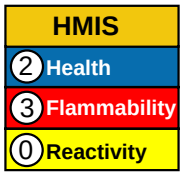
DFG (Germany) MAK
TWA: 50 ppm; PEAK: 200 ppm; skin.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Danger!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Colorless liquid; sickly, sweet odor. Irritating to eyes/skin/respiratory tract. Other Acute Effects: weakness, headache, dizziness, confusion, insomnia. Chronic Effects: liver/kidney damage, may cause birth defects. Flammable.

Potential Health Effects

Target Organs: Skin, liver, kidneys, central nervous system.
Primary Entry Routes: Inhalation, skin contact/absorbtion.
Acute Effects
Inhalation: The vapor is highly discomforting to the upper respiratory tract. Inhalation hazard is increased at higher temperatures.

Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.
If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Central nervous system (CNS) depression may include nonspecific discomfort, symptoms of giddiness, headache, dizziness, nausea, anesthetic effects, slowed reaction time, slurred speech and may progress to unconsciousness.
Serious poisonings may result in respiratory depression and may be fatal.

Eye: The liquid produces a high level of eye discomfort and is capable of causing pain and severe conjunctivitis.
Corneal injury may develop, with possible permanent impairment of vision, if not promptly and adequately treated.
The vapor is discomforting to the eyes if exposure is prolonged.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.

Skin: The liquid may produce skin discomfort following prolonged contact.
Defatting and/or drying of the skin may lead to dermatitis and it is absorbed by skin.
Toxic effects may result from skin absorption.
Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Class A4, Not classifiable as a human carcinogen; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.
Chronic toluene habituation occurs following intentional abuse (glue-sniffing) or from occupational exposure. Ataxia, incoordination and tremors of the hands and feet (as a consequence of diffuse cerebral atrophy), headache, abnormal speech, transient memory loss, convulsions, coma, drowsiness, reduced color perception, frank blindness, nystagmus (rapid, involuntary eye-movements), decreased hearing leading to deafness and mild dementia have all been associated with chronic abuse.
Peripheral nerve damage, encephalopathy, giant axonopathy, electrolyte disturbances in the cerebrospinal fluid and abnormal computer tomographic (CT) scans are common amongst toluene addicts. Although toluene abuse has been linked with kidney disease, this does not commonly appear in cases of occupational toluene exposures. Cardiac and hematological toxicity are however associated with chronic toluene exposure. Cardiac arrhythmia, multifocal and premature ventricular contractions and supraventricular tachycardia are present in 20% of patients who abused toluene-containing paints.
Previous suggestions that chronic toluene inhalation produced human peripheral neuropathy have largely been discounted. However central nervous system (CNS) depression is well documented where blood toluene levels exceed 2.2 mg%. Toluene abusers can achieve transient circulating concentrations of 6.5 mg%. Amongst workers exposed for a median time of 29 years to toluene no subacute effects on neurasthenic complaints and pyschometric test results could be established.
The prenatal toxicity of very high toluene concentrations has been documented for several animal species and man. Malformations indicative of specific teratogenicity have not generally been found. The toxicity described in the literature takes the form of embryo death or delayed fetal growth and delayed skeletal system development. Permanent damage of children has been seen only when mothers had suffered from chronic intoxication as a result of "sniffing".

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor.

See DOT ERG

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.
After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: Following acute or short-term repeated exposures to toluene:
1. Toluene is absorbed across to alveolar barrier, the blood/air mixture being 11.2/15.6 (at 37 °C) The order of toluene, in expired breath, is of the order of 18 ppm following sustained exposure to 100 ppm.
The tissue/blood proportion is 1/3 except in adipose where the proportion is 8/10.
2.Metabolism by microsomal mono-oxygenation, results in the production of hippuric acid. This may be detected in the urine in amounts between 0.5 and 2.5 g/24hr which represents, on average 0.8 gm/gm of creatinine.
The biological half life of hippuric acid is in the order of 1-2 hours.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
8.Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients.
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

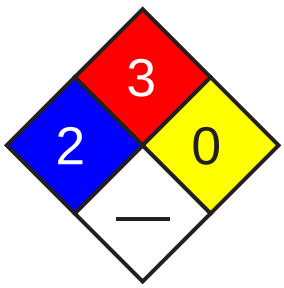
Determinant	Index	Sampling Time	Comments
Hippuric acid in urine	2.5 gm/gm creatinine	End of shift Last 4 hrs of shift	B,NS
Toluene in venous blood	1 mg/L	End of shift	SQ
Toluene in end-exhaled air		End of shift	SQ

NS: Non-specific determinant; also observed after exposure to other material
SQ: Semi-quantitative determinant - Interpretation may be ambiguous; should be used as a screening test or confirmatory test.
B: Background levels occur in specimens collected from subjects NOT exposed.

Section 5 - Fire-Fighting Measures

Flash Point: 4 °C Closed Cup
Autoignition Temperature: 480 °C
LEL: 1.2% v/v
UEL: 7.1% v/v
Extinguishing Media: Foam, dry chemical powder, BCF (where regulations permit), carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are highly flammable.
Severe fire hazard when exposed to heat, flame and/or oxidizers.
Vapor forms an explosive mixture with air.
Severe explosion hazard, in the form of vapor, when exposed to flame or spark. Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion/decomposition with violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO) and carbon dioxide (CO_2).

See DOT ERG



Fire Diamond

Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Nitric acid with toluene, produces nitrated compounds which are explosive.

Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
Fight fire from a safe distance, with adequate cover.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control the fire and cool adjacent area. Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protective location.
If safe to do so, remove containers from path of fire.

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.

See DOT ERG

Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways. Consider evacuation.
No smoking, bare lights or ignition sources. Increase ventilation.
Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.

Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of exposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights, heat or ignition sources.
When handling, DO NOT eat, drink or smoke.
Vapor may ignite on pumping or pouring due to static electricity.
DO NOT use plastic buckets. Ground and secure metal containers when dispensing or pouring product. Use spark-free tools when handling.
Avoid contact with incompatible materials.
Keep containers securely sealed. Avoid physical damage to containers.
Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Use good occupational work practices. Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.

Recommended Storage Methods: Metal can; Metal drum; Metal safety cans. Packing as supplied by manufacturer.
Plastic containers may only be used if approved for flammable liquid.
Check that containers are clearly labeled and free from leaks.

Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area; local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in special circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator. Correct fit is essential to ensure adequate protection.
Provide adequate ventilation in warehouses and enclosed storage areas.

In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.

Personal Protective Clothing/Equipment:

Eyes: Safety glasses with side shields; chemical goggles. Full face shield.
DO NOT wear contact lenses. Contact lenses pose a special hazard; soft contact lenses may absorb irritants and all lenses concentrate them.

Hands/Feet: Wear chemical protective gloves, eg. PVC. Wear safety footwear.

Respiratory Protection:

Exposure Range >200 to <500 ppm: Air Purifying, Negative Pressure, Half Mask
Exposure Range 500 to unlimited ppm: Self-contained Breathing Apparatus, Pressure Demand, Full Face
Cartridge Color: black

Other: Overalls. Barrier cream. Eyewash unit.

Glove Selection Index:

PE/EVAL/PE ..... Best selection
VITON/CHLOROBUTYL ..... Best selection
VITON ..... Best selection
PVA ..... Best selection
TEFLON ..... Satisfactory; may degrade after 4 hours continuous immersion
SARANEX-23 2-PLY..... Poor to dangerous choice for other than short-term immersion
CPE ..... Poor to dangerous choice for other than short-term immersion
VITON/NEOPRENE ..... Poor to dangerous choice for other than short-term immersion
SARANEX-23 ..... Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL..... Poor to dangerous choice for other than short-term immersion
NITRILE+PVC ..... Poor to dangerous choice for other than short-term immersion
NITRILE ..... Poor to dangerous choice for other than short-term immersion
BUTYL ..... Poor to dangerous choice for other than short-term immersion
PVC..... Poor to dangerous choice for other than short-term immersion
NEOPRENE..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear highly flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Odor Threshold: 2.14 ppm
Vapor Pressure (kPa): 2.93 at 20 °C
Vapor Density (Air=1): 3.2
Formula Weight: 92.14
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 20 °C
Evaporation Rate: 2.4 (BuAc=1)

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 111 °C (232 °F) at 760 mm Hg
Freezing/Melting Point: -95 °C (-139 °F)
Volatile Component (% Vol): 100
Water Solubility: < 1 mg/mL at 18 °C

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Segregate from strong oxidizers.

Section 11 - Toxicological Information

Toxicity

Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 636 mg/kg
Inhalation (human) TC_{Lo}: 100 ppm
Inhalation (man) TC_{Lo}: 200 ppm
Inhalation (rat) LC_{50}: > 26700 ppm/1h
Dermal (rabbit) LD_{50}: 12124 mg/kg
Reproductive effector in rats

Irritation

Skin (rabbit): 20 mg/24h-moderate
Skin (rabbit): 500 mg - moderate
Eye (rabbit): 0.87 mg - mild
Eye (rabbit): 2 mg/24h - SEVERE
Eye (rabbit): 100 mg/30sec - mild

See *RTECS* XS 5250000, for additional data.

Section 12 - Ecological Information

Environmental Fate: If released to soil, it will be lost by evaporation from near-surface soil and by leaching to the groundwater. Biodegradation occurs both in soil and groundwater, but it is apt to be slow especially at high concentrations, which may be toxic to microorganisms. The presence of acclimated microbial populations may allow rapid biodegradation. It will not significantly hydrolyze in soil or water under normal environmental conditions. If released into water, its concentration will decrease due to evaporation and biodegradation. This removal can be rapid or take several weeks, depending on temperature, mixing conditions, and acclimation of microorganisms. It will not significantly adsorb to sediment or bioconcentrate in aquatic organisms. If released to the atmosphere, it will degrade by reaction with photochemically produced hydroxyl radicals (half-life 3 hr to slightly over 1 day) or be washed out in rain. It will not be subject to direct photolysis.

Ecotoxicity: LC_{50} Aedes aegypti-4th instar (mosquito larvae) 22 mg/l /Conditions of bioassay not specified; LC_{50} Cyprinodon variegatus (sheepshead minnow) 277-485 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Calandra granaria (grain weevil) 210 mg/l /in air; LC_{50} Cancer magister (crab larvae stage I) 28 ppm/96 hr /Conditions of bioassay not specified; LC_{50} Crangon franciscorum (shrimp) 4.3 ppm 96 hr /Conditions of bioassay not specified; LC_{50} Artemia salina (brine shrimp) 33 mg/l 24 hr /Conditions of bioassay not specified; LC_{50} Morone saxatilis (striped bass) 7.3 mg/l 96 hr /Conditions of bioassay not specified; LC_{50} Pimephales promelas (fathead minnows) 55-72 mg/l (embryos), 25-36 mg/l (1-day posthatch protolarvae), and 26-31 mg/l (30-day-old minnows)/ 96 hour /Conditions of bioassay not specified

Henry's Law Constant: 0.0067

BCF: eels 13.2

Biochemical Oxygen Demand (BOD): 0%, 5 days

Octanol/Water Partition Coefficient: log K_{ow} = 2.69

Soil Sorption Partition Coefficient: K_{oc} = silty loam 37

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Shipping Name and Description: Toluene
ID: UN1294
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U220 Toxic Waste

CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001, per CWA Section 307(a) 1000 lb (453.5 kg)

SARA 40 CFR 372.65: Listed

SARA EHS 40 CFR 355: Not listed

TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

Material Safety Data Sheet Collection
Genium group inc.
1171 RiverFront Center, Amsterdam, NY 12010
(518) 842-4111

Issue Date: 2006-06

Section 1 - Chemical Product and Company Identification 61

Material Name: Xylene **CAS Number:** 1330-20-7
Chemical Formula: C_8H_{10}
Structural Chemical Formula: $C_6H_4(CH_3)_2$
EINECS Number: 215-535-7
ACX Number: X1001166-8
Synonyms: BENZENE,DIMETHYL-; COMPONENT 1 (83%): XYLENES; COMPONENT 2 (17%): ETHYL BENZENE; DIMETHYLBENZENE; DIMETHYLBENZENES; EPA PESTICIDE CHEMICAL CODE 086802; KSYLEN; METHYL TOLUENE; METHYLTOLUENE; VIOLET 3; XILOLI; XYLENE; XYLENEN; XYLOL; XYLOLE
General Use: A strong solvent for general use in the manufacture of paints, varnishes, lacquers, thinners, inks, rubber, pesticides, herbicides and paint strippers.

Section 2 - Composition / Information on Ingredients

Name	CAS	%
xylene	1330-20-7	> 95

OSHA PEL
TWA: 100 ppm; 435 mg/m^3.

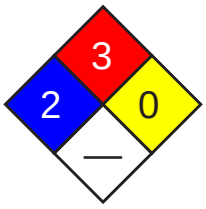
NIOSH REL
TWA: 100 ppm, 435 mg/m^3; STEL: 150 ppm, 655 mg/m^3.

DFG (Germany) MAK
TWA: 100 ppm; PEAK: 200 ppm; skin.

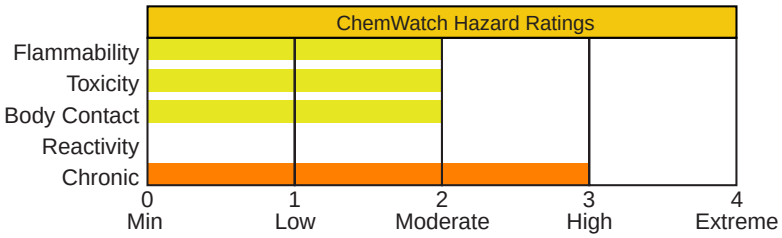
ACGIH TLV
TWA: 100 ppm; STEL: 150 ppm.

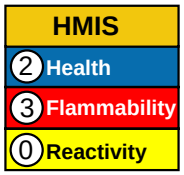
EU OEL
TWA: 50 ppm; STEL: 100 ppm.

Section 3 - Hazards Identification



Fire Diamond





ANSI Signal Word
Warning!


Flammable

☆☆☆☆☆ Emergency Overview ☆☆☆☆☆

Clear, sweet smelling liquid. Irritating to eyes/skin/respiratory tract. Other Acute Effects: dizziness, nausea, drowsiness. Chronic Effects: dermatitis, kidney/liver/peripheral nerve damage. May cause birth defects (animal data). Flammable.

Potential Health Effects

Target Organs: central nervous system (CNS), eyes, gastrointestinal (GI) tract, liver, kidneys, skin
Primary Entry Routes: inhalation, skin absorption (slight), eye contact, ingestion
Acute Effects
Inhalation: Xylene is a central nervous system depressant. The vapor is discomforting to the upper respiratory tract and may be harmful if inhaled.
Inhalation hazard is increased at higher temperatures.
Toxic effects are increased by consumption of alcohol.
Acute effects from inhalation of high concentrations of vapor are pulmonary irritation, including coughing, with nausea; central nervous system depression - characterized by headache and dizziness, increased reaction time, fatigue and loss of coordination.

If exposure to highly concentrated solvent atmosphere is prolonged this may lead to narcosis, unconsciousness, even coma and possible death.
Headache, fatigue, lassitude, irritability and gastrointestinal disturbances (e.g., nausea, anorexia and flatulence) are the most common symptoms of xylene overexposure. Injury to the heart, liver, kidneys and nervous system has also been noted among workers. Transient memory loss, renal impairment, temporary confusion and some evidence of disturbance of liver function was reported in three workers overcome by gross exposure to xylene (10000 ppm). One worker died and autopsy revealed pulmonary congestion, edema, and focal alveolar hemorrhage.
Volunteers inhaling xylene at 100 ppm for 5 to 6 hours showed changes in manual coordination, reaction time and slight ataxia. Tolerance developed during the workweek but was lost over the weekend. Physical exercise may antagonize this effect. Xylene body burden in humans exposed to 100 or 200 ppm xylene in air depends on the amount of body fat with 4% to 8% of total absorbed xylene accumulating in human adipose tissues.

Eye: The liquid is highly discomforting to the eyes and is capable of causing a mild, temporary redness of the conjunctiva (similar to wind-burn), temporary impairment of vision and/or other transient eye damage/ulceration.
The vapor is highly discomforting to the eyes.
The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
Corneal changes have been reported in furniture polishers exposed to xylene.

Skin: The liquid is highly discomforting to the skin and may cause drying of the skin, which may lead to dermatitis and it is absorbed by the skin.
Toxic effects may result from skin absorption.
Open cuts, abraded or irritated skin should not be exposed to this material.
The material may accentuate any pre-existing skin condition.
The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterized by skin redness (erythema) and swelling (edema) which may progress to vesiculation, scaling and thickening of the epidermis. Histologically there may be intercellular edema of the spongy layer (spongiosis) and intracellular edema of the epidermis.

Ingestion: Considered an unlikely route of entry in commercial/industrial environments.
The liquid may produce gastrointestinal discomfort and may be harmful if swallowed. Ingestion may result in nausea, pain and vomiting. Vomit entering the lungs by aspiration may cause potentially lethal chemical pneumonitis.

Carcinogenicity: NTP - Not listed; IARC - Group 3, Not classifiable as to carcinogenicity to humans; OSHA - Not listed; NIOSH - Not listed; ACGIH - Not listed; EPA - Class D, Not classifiable as to human carcinogenicity; MAK - Not listed.

Chronic Effects: Chronic solvent inhalation exposures may result in nervous system impairment and liver and blood changes.
Prolonged or continuous skin contact with the liquid may cause defatting with drying, cracking, irritation and dermatitis following.
Small excess risks of spontaneous abortion and congenital malformation was reported amongst women exposed to xylene in the first trimester of pregnancy. In all cases however the women had also been exposed to other substances.
Evaluation of workers chronically exposed to xylene has demonstrated a lack of genotoxicity. Exposure to xylene has been associated with increased risks of hemopoietic malignancies but, again simultaneous exposure to other substances (including benzene) complicate the picture. A long-term gavage study of mixed xylenes (containing 17% ethyl benzene) found no evidence of carcinogenic activity in rats and mice of either sex.
Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).

Section 4 - First Aid Measures

Inhalation: Remove to fresh air.
Lay patient down. Keep warm and rested.
If available, administer medical oxygen by trained personnel.
If breathing is shallow or has stopped, ensure clear airway and apply resuscitation. Transport to hospital or doctor, without delay.

Eye Contact: Immediately hold the eyes open and flush continuously for at least 15 minutes with fresh running water. Ensure irrigation under eyelids by occasionally lifting the upper and lower lids.
Transport to hospital or doctor without delay. Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

Skin Contact: Immediately remove all contaminated clothing, including footwear (after rinsing with water).
Wash affected areas thoroughly with water (and soap if available).
Seek medical attention in event of irritation.

Ingestion: Contact a Poison Control Center.
Do NOT induce vomiting. Give a glass of water.

After first aid, get appropriate in-plant, paramedic, or community medical support.

Note to Physicians: For acute or short-term repeated exposures to xylene:
1.Gastrointestinal absorption is significant with ingestions.

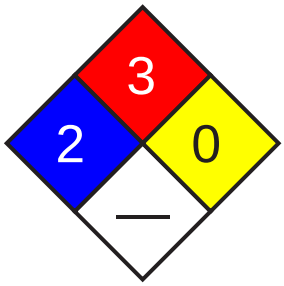
For ingestions exceeding 1-2 mL (xylene)/kg, intubation and lavage with cuffed endotracheal tube is recommended. The use of charcoal and cathartics is equivocal.
2.Pulmonary absorption is rapid with about 60-65% retained at rest.
3.Primary threat to life from ingestion and/or inhalation is respiratory failure.
4.Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO_2 <50 mm Hg or pCO_2 >50 mm Hg) should be intubated.
5.Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
6.A chest x-ray should be taken immediately after stabilization of breathing and circulation to document aspiration and detect the presence of pneumothorax.
7.Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitization to catecholamines.
Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
BIOLOGICAL EXPOSURE INDEX - BEI
These represent the determinants observed in specimens collected from a healthy worker exposed at the Exposure Standard (ES or TLV):

Determinant	Index	Sampling Time	Comments
Methylhippuric acids in urine	1.5 gm/gm creatinine	End of shift	
	2 mg/min	Last 4 hrs of shift.	

Section 5 - Fire-Fighting Measures

Flash Point: 25.6 °C
Autoignition Temperature: 241 °C
LEL: 1.0% v/v
UEL: 7.0% v/v
Extinguishing Media: Alcohol stable foam; dry chemical powder; carbon dioxide.
Water spray or fog - Large fires only.
General Fire Hazards/Hazardous Combustion Products: Liquid and vapor are flammable.
Moderate fire hazard when exposed to heat or flame.
Vapor forms an explosive mixture with air.
Moderate explosion hazard when exposed to heat or flame.
Vapor may travel a considerable distance to source of ignition.
Heating may cause expansion or decomposition leading to violent rupture of containers.
On combustion, may emit toxic fumes of carbon monoxide (CO).
Other combustion products include carbon dioxide (CO_2).
Fire Incompatibility: Avoid contamination with strong oxidizing agents as ignition may result.
Fire-Fighting Instructions: Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
If safe, switch off electrical equipment until vapor fire hazard removed.
Use water delivered as a fine spray to control fire and cool adjacent area.
Avoid spraying water onto liquid pools.
Do not approach containers suspected to be hot.
Cool fire-exposed containers with water spray from a protected location.
If safe to do so, remove containers from path of fire.

See DOT ERG



Fire Diamond

Section 6 - Accidental Release Measures

Small Spills: Remove all ignition sources. Clean up all spills immediately.
Avoid breathing vapors and contact with skin and eyes.
Control personal contact by using protective equipment.
Contain and absorb small quantities with vermiculite or other absorbent material. Wipe up. Collect residues in a flammable waste container.
Large Spills: Clear area of personnel and move upwind.
Contact fire department and tell them location and nature of hazard.
May be violently or explosively reactive. Wear breathing apparatus plus protective gloves. Prevent, by any means available, spillage from entering drains or waterways.
No smoking, bare lights or ignition sources. Increase ventilation.

See DOT ERG

Stop leak if safe to do so. Water spray or fog may be used to disperse/absorb vapor. Contain spill with sand, earth or vermiculite.
Use only spark-free shovels and explosion proof equipment.
Collect recoverable product into labeled containers for recycling.
Absorb remaining product with sand, earth or vermiculite.
Collect solid residues and seal in labeled drums for disposal.
Wash area and prevent runoff into drains.
If contamination of drains or waterways occurs, advise emergency services.
Regulatory Requirements: Follow applicable OSHA regulations (29 CFR 1910.120).

Section 7 - Handling and Storage

Handling Precautions: Avoid all personal contact, including inhalation.
Wear protective clothing when risk of overexposure occurs.
Use in a well-ventilated area. Prevent concentration in hollows and sumps.
DO NOT enter confined spaces until atmosphere has been checked.
Avoid smoking, bare lights or ignition sources.
Avoid generation of static electricity. DO NOT use plastic buckets.
Ground all lines and equipment. Use spark-free tools when handling.
Avoid contact with incompatible materials.
When handling, DO NOT eat, drink or smoke.
Keep containers securely sealed when not in use. Avoid physical damage to containers. Always wash hands with soap and water after handling.
Work clothes should be laundered separately.
Observe manufacturer's storing and handling recommendations. Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Recommended Storage Methods: Metal can; metal drum. Packing as recommended by manufacturer.
Check all containers are clearly labeled and free from leaks.
Plastic containers may only be used if approved for flammable liquids.
Regulatory Requirements: Follow applicable OSHA regulations.

Section 8 - Exposure Controls / Personal Protection

Engineering Controls: Use in a well-ventilated area. Local exhaust ventilation may be required for safe working, i. e. , to keep exposures below required standards; otherwise, PPE is required.
CARE: Use of a quantity of this material in confined space or poorly ventilated area, where rapid build-up of concentrated atmosphere may occur, could require increased ventilation and/or protective gear.
General exhaust is adequate under normal operating conditions.
Local exhaust ventilation may be required in specific circumstances.
If risk of overexposure exists, wear NIOSH-approved respirator.
Correct fit is essential to obtain adequate protection.
Provide adequate ventilation in warehouse or closed storage areas.
In confined spaces where there is inadequate ventilation, wear full-face air supplied breathing apparatus.
Personal Protective Clothing/Equipment:
Eyes: Safety glasses with side shields; or as required, chemical goggles.
Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.
Hands/Feet: Barrier cream with polyethylene gloves; Butyl rubber gloves or Neoprene gloves or PVC gloves.
Safety footwear.
Do NOT use this product to clean the skin.
Other: Overalls. Impervious protective clothing.
Eyewash unit.
Ensure there is ready access to an emergency shower.
Glove Selection Index:

PE/EVAL/PE	Best selection
PVA	Best selection
VITON	Best selection
TEFLON	Best selection
PVDC/PE/PVDC	Poor to dangerous choice for other than short-term immersion
NATURAL+NEOPRENE	Poor to dangerous choice for other than short-term immersion
NEOPRENE/NATURAL	Poor to dangerous choice for other than short-term immersion
NITRILE+PVC	Poor to dangerous choice for other than short-term immersion
HYPALON	Poor to dangerous choice for other than short-term immersion
NAT+NEOPR+NITRILE	Poor to dangerous choice for other than short-term immersion
BUTYL	Poor to dangerous choice for other than short-term immersion
BUTYL/NEOPRENE	Poor to dangerous choice for other than short-term immersion

NITRILE..... Poor to dangerous choice for other than short-term immersion
NEOPRENE..... Poor to dangerous choice for other than short-term immersion
PVC..... Poor to dangerous choice for other than short-term immersion

Section 9 - Physical and Chemical Properties

Appearance/General Info: Clear colorless flammable liquid with a strong aromatic odor; floats on water. Mixes with most organic solvents.

Physical State: Liquid
Odor Threshold: 5.00 x10^{-5} ppm
Vapor Pressure (kPa): 0.5 at 15 °C
Vapor Density (Air=1): 3.66 at 15 °C
Formula Weight: 106.18
Specific Gravity (H_2O=1, at 4 °C): 0.87 at 15 °C
Evaporation Rate: 0.7 Bu Ac=1

pH: Not applicable
pH (1% Solution): Not applicable.
Boiling Point: 137 °C (279 °F) to 140 °C (284 °F)
Freezing/Melting Point: -47 °C (-53 °F)
Volatile Component (% Vol): 100
Water Solubility: Practically insoluble in water

Section 10 - Stability and Reactivity

Stability/Polymerization/Conditions to Avoid: Product is considered stable. Hazardous polymerization will not occur.
Storage Incompatibilities: Avoid storage with oxidizers.

Section 11 - Toxicological Information

Toxicity

Oral (human) LD_{Lo}: 50 mg/kg
Oral (rat) LD_{50}: 4300 mg/kg
Inhalation (human) TC_{Lo}: 200 ppm
Inhalation (man) LC_{Lo}: 10000 ppm/6h
Inhalation (rat) LC_{50}: 5000 ppm/4h
Reproductive effector in rats

Irritation

Skin (rabbit):500 mg/24h moderate
Eye (human): 200 ppm irritant
Eye (rabbit): 87 mg mild
Eye (rabbit): 5 mg/24h SEVERE

See *RTECS* ZE 2100000, for additional data.

Section 12 - Ecological Information

Environmental Fate: Most of the xylenes are released into the atmosphere where they may photochemically degrade by reaction with hydroxyl radicals (half-life 1-18 hr). The dominant removal process in water is volatilization. Xylenes are moderately mobile in soil and may leach into groundwater where they are known to persist for several years, despite some evidence that they biodegrade in both soil and groundwater. Bioconcentration is not expected to be significant.

Ecotoxicity: LC_{50} Rainbow trout 13.5 mg/l/96 hr /Conditions of bioassay not specified; LD_{50} Goldfish 13 mg/l/24 hr /Conditions of bioassay not specified

Henry's Law Constant: 0.22

BCF: estimated at 2.14 to 2.20

Octanol/Water Partition Coefficient: log K_{ow} = 3.12 to 3.20

Soil Sorption Partition Coefficient: K_{OC} = 48 to 68

Section 13 - Disposal Considerations

Disposal: Consult manufacturer for recycling options and recycle where possible.
Follow applicable federal, state, and local regulations.
Incinerate residue at an approved site.
Recycle containers where possible, or dispose of in an authorized landfill.

Section 14 - Transport Information

DOT Hazardous Materials Table Data (49 CFR 172.101):

Note: This material has multiple possible HMT entries. Choose the appropriate one based on state and condition of specific material when shipped.

Shipping Name and Description: Xylenes
ID: UN1307
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: II - Medium Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: IB2, T4, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 202 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 5 L **Cargo aircraft only:** 60 L
Vessel Stowage: **Location:** B **Other:**

Shipping Name and Description: Xylenes
ID: UN1307
Hazard Class: 3 - Flammable and combustible liquid
Packing Group: III - Minor Danger
Symbols:
Label Codes: 3 - Flammable Liquid
Special Provisions: B1, IB3, T2, TP1
Packaging: **Exceptions:** 150 **Non-bulk:** 203 **Bulk:** 242
Quantity Limitations: **Passenger aircraft/rail:** 60 L **Cargo aircraft only:** 220 L
Vessel Stowage: **Location:** A **Other:**

Section 15 - Regulatory Information

EPA Regulations:

RCRA 40 CFR: Listed U239 Ignitable Waste
CERCLA 40 CFR 302.4: Listed per CWA Section 311(b)(4), per RCRA Section 3001 100 lb (45.35 kg)
SARA 40 CFR 372.65: Listed
SARA EHS 40 CFR 355: Not listed
TSCA: Listed

Section 16 - Other Information

Disclaimer: Judgments as to the suitability of information herein for the purchaser's purposes are necessarily the purchaser's responsibility. Although reasonable care has been taken in the preparation of such information, Genium Group, Inc. extends no warranties, makes no representations, and assumes no responsibility as to the accuracy or suitability of such information for application to the purchaser's intended purpose or for consequences of its use.

ARCADIS

Attachment F

Emergency Action Plan and Route to Hospital

EMERGENCY ACTION PLAN

Emergency Contact List

Site address: 1015 to 1035 Belleville Turnpike, Kearny, NJ 07032	
Emergency Contact	**Phone**
Local Police – Kearny Police Department	911 (if appropriate) and 201.998.1313
Local Ambulance – Emergency Services	911
Local Fire Department – Kearny Fire Department	911 (if appropriate) and 201.991.1402
Local Hospital – Saint Michael's Medical Center	973.877.5000
Local Weather Data – The Weather Channel	www.weather.com
Poison Control	800.332.3073
National Response Center (all spills in reportable quantities)	800.424.8802
U.S. Coast Guard (spills to water)	800.424.8802
Project Manager – Alain P. Hebert	Office: 609.860.0590 x 232 Cell: 609.903.6228
Site Manager – Meredith K. Hayes	Office: 212.549.1860 x 11 Cell: 631.682.0632
Health and Safety Manager – Chuck Webster	Office: 315.247-5971
Client Contact – NA	

List the Emergency Notification Procedure for the project:

Step 1: Call 911 and take emergency care steps (FA/CPR) if necessary
Step 2: Notify all other on-site workers if applicable and safe to do so
Step 3: Notify Project Manager
Step 4: Notify Site Manager

If emergency attention is not needed but professional medical attention is necessary, the employee will be taken to (see hospital route):

Medical Facility: Saint Michael's Medical Center
Address: 111 Central Ave
Newark, NJ 07102

Phone Number: 973.877.5000

Emergency Supplies and Equipment List

Emergency Supplies and Equipment (check all that apply)	Location on Project Site
☒ First Aid Kit (type):	ARCADIS trailer and/or vibracore boat as applicable
☒ Fire Extinguisher	
☒ Mobile Phone ☐ Satellite Phone	ARCADIS trailer, vibracore boat and/or on personnel as applicable
☒ Traffic Cones	ARCADIS trailer and/or vibracore boat as applicable
☐ Walkie Talkies	
☒ Water or Other Fluid Replenishment	
☐ Eye Wash/Quick Drench Station	
☒ Eye Wash Bottle	
☒ Wash and Dry Towelettes	
☒ Sunscreen (SPF 15 or higher)	
☒ Insect Repellant	
☒ Chemical Spill Kit	
☐ *Other (specify):*	